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## WEST INDIES CONFERENCE.

THE first meeting of the West Indies Conference has been convened for the latter half of January, 1929, and will be held in Barbados. This event presents possibilities of great significance for the future of these colonies and much will depend on the successful outcome of this, the first meeting. For many years proposals have been made for the federation in some form or other of the nine colonies, if we include Bermuda in the North Atlantic and British Honduras and British Guiana on the American mainland, that form the British West Indies. Great difficulties have been experienced in obtaining any form of agreement, but the great upheaval caused by the War has stimulated the movement towards some form of organisation which would enable these various colonies to co-operate together in matters of common interest. In 1926, Mr. Amery, the Secretary of State for the Colonies summoned representatives of these colonies to consider the establishment of a standing conference to deal with these matters and the result was that the constitution of a West Indies Conference was drawn up which has since been accepted by all the colonies in this area. The constitution provides for periodical conferences to be held alternatively in London and the West Indies and the body will have purely advisory powers and any conclusions it arrives at will be subject to ratification, later on, by the Legislature of the participating colonies. The political machinery set up in respect of the members, who will usually be appointed by their respective Governments, is expressly modelled, with certain modifications, on the Imperial Conference.

The Chairman of this, the first meeting of the Joint Standing Conference is to be Sir Edward Davson, a name well known throughout the West Indies with which he has intimate connections and a deep knowledge. The Secretary of the Conference nominated by the Secretary of State is Mr. R. R. Sedgwick, an Assistant Principal Clerk in the Colonial Office. It will be recollected that this officer was Secretary to the Parliamentary Commission that visited British Guiana a couple of years ago.

At the time of going to press the agenda for the meeting has not yet been received in its finally approved form, but it is probable that provision will be made for discussion on such matters as customs tariffs, joint trade representation in the United Kingdom and Canada and improvements

in communications. In connection with the latter the advantage of an intercolonial air service will doubtless be stressed and the opportunity taken to consider the report of the West Indian Aviation Committee that was issued last year. The matter of agricultural organisation and research is also likely to figure largely before the Conference. The Government of Barbados has, it is understood, already put down for discussion the question of co-ordination in agricultural administration in the West Indies with a view to ascertaining the possibility of providing, by co-operation between the various Governments, a more complete, effective and incidentally economical agricultural organisation than is practicable so long as each colony in the West Indies attempts to provide itself with a complete and self-contained agricultural staff. The Government of the Windward Islands also raises the possibility of a unified agricultural service for Trinidad, the Leeward and Windward Islands.

This proposal has come at an opportune moment as the time is now ripe for a thorough investigation of the machinery that at present exists for helping agriculture, which is the primary and in many instances, the sole industry of all these colonies. Many changes have taken place since the War and new influences have arisen, not the least of which has been the opening of the Imperial College of Tropical Agriculture in the West Indies. This Institution has now become firmly established and its aims and objects are becoming better known. Its functions are dual, namely the provision of training in the higher branches of agriculture, and research. So far as the latter part of its functions is concerned, the College has been recognised by the Lovat Commission's Report and the Imperial Agricultural Research Conference as a Research Station and the respective functions of a Research Station as distinct from those of an Agricultural Department have been very clearly defined so as to avoid so far as possible any chance of overlapping or duplication of work. The work of the Research Station is to be more especially in the nature of "long range research," involving prolonged investigations into fundamental matters that are usually beyond the scope or means at the disposal of an Agricultural Department of a Colonial Government. The functions of the latter should be more in the direction of experiment and demonstrations involving the application of results obtained as the results of experiment and research. As examples, it may be worth while noting some of the researches that the College is at present undertaking. These include fundamental research into the character and nature of soils in the tropics, studies on the genetics of bananas and sugar-cane, low temperature research into the transport of tropical fruits, particularly bananas, and the factors that underlie the incidence of certain diseases such as Panama disease. Another line involving considerable detailed research is the study of the economics of peasant agriculture. Other new lines of research will include a prolonged investigation into the cacao crop both from the point of view of genetics and physiology may also be quoted. These few instances will serve to indicate that there are certain fundamental lines of research that have to be carried out before real progress can be made. They involve considerable expenditure in plant and equipment and necessitate the employment of very specialised and highly qualified staff. It is obviously impossible for the Agricultural Department of a small colony to undertake work of this nature, as the expense and need for continuity over a long series of years, prohibit it. One central Research Station of this nature should therefore suffice to meet the needs of a group of colonies such as the West Indies. It is, however, absolutely essential that if the Research Station is to function properly it should keep in the closest contact with the various Agricultural Departments of the area which it serves and have a real understanding with them as to a correct apportionment of the work to be undertaken.

Turning to the Agricultural Departments themselves, it is possible that the Conference will discuss the possibility of closer co-operation between them. At present each colony has its own Department and in some of the smaller islands, the officers are finding great difficulty in carrying on. It is obviously impossible to expect the best work from an officer if he knows that he is a member and often the sole member of a minute Department and that the resources of the colony are such, that he feels that he is not likely to get the financial support necessary to put his schemes for improvement into effect. Incidentally, an officer so situated feels that he is stagnating and sees little prospects of promotion. Agricultural science is increasing so rapidly these post war days that unless a man is given facilities, his efficiency diminishes and he gets behind hand. It may not be feasible to reduce the number of Agricultural Departments materially just at present, but undoubtedly the tendency in the future will be to have fewer but larger and more efficient Agricultural Departments, the smaller departments amalgamating to form a single administrative agricultural service on the lines suggested by the Government of the Windward Islands. If this can be done and it will doubtless be seriously considered, when communications, which are at present the crux, improve, there will be a chance not only of attracting better trained men to the service, but also of retaining them instead of losing so many through discontent with future prospects, as has happened in the West Indies in the past. One of the results of the present Conference will be to emphasize the necessity for the various Agricultural Departments in the Caribbean and the Imperial College to get closer together and, along with this, the proposals of the Imperial Agricultural Conference of 1927 regarding the formation of a unified agricultural service will of necessity have to be considered.

# DAIRYING IN THE TROPICS.

By H. V. M. Metivier, O.B.E., B.Sc., M.R.C.V.S.

*[We publish below a summary of Captain H. V. M. Metivier's lecture to the Agricultural Society on the dairy work carried out at the Government Farm, Trinidad. In his opening remarks Captain Metivier congratulated the Society on appointing a Committee to go into the question of the registration of livestock and on their decision to hold an exhibition of livestock in 1929. He pointed out that the registration of livestock was a very important piece of work as it was essential to keep track of the valuable pedigree stock which had recently been introduced into Trinidad from Canada. The holding of an exhibition was considered as a means equally important towards keeping up the standard of the stock in the Colony.]*

The original function of the Government dairy farm, established fifty years ago, was to supply Government Institutions with milk, as considerable difficulty had been experienced in the past in obtaining a good and regular supply for hospitals, asylums and other such centres. The work of the farm was soon however extended to that of a breeding station; work which was carried out by keeping stud animals and by holding annual sales of pure bred and grade cattle for milk and work, horses and mules, and pure bred pigs and poultry.

At first, the farm did not pay its way and complaints were received on the inadequacy of the milk supply. This unsatisfactory state of affairs was investigated by the Government and it was found that there were three main factors responsible. Firstly, cattle had been imported indiscriminately and no definite breeding principles had been adopted to improve the stock, secondly, dairy stock was not handled as such but was treated in the same manner as ordinary estate cattle, and thirdly, no provisions had been made to secure fodder for the dairy stock during the dry season when pastures are all parched up, and it is essential that cows should be supplied with bulky succulent foods. Another great defect in the management of the cattle was that the bulls were allowed to run with the cows and the Zebu (Indian humped cattle) were mixed up with the dairy cattle. It often happened therefore that when an Indian bull was turned out in the herd one of the best cows would be in oestrum, and consequently the progeny was no improvement on the dam for milk production. Then again, when a grade bull was turned out with the herd one of the best pure bred Indian cows would be in oestrum and the result would be throwing back the Indian cattle instead of improving them.

In 1923 the general policy of the farm was altered. Indian cattle were segregated and the Friesian breed definitely selected for grading up dairy stock. All dairy cattle were to be treated purely as such and during the dry season provisions were made for growing the necessary fodder on the farm. Indian cattle still received considerable attention as they commanded high prices and were in great demand as work animals, not only in Trinidad, but throughout the West Indies.

The Friesian, erroneously called Holstein in the West Indies, was selected because of the excellent results obtained from the half bred Friesians as compared with any of the other breeds imported in the past. There were at the farm at least a dozen cows, daughters of the pure bred Friesian bull Alick, imported from Louisiana many years ago and as soon as these animals were properly handled they easily averaged 40 lb. of milk a day when fresh. Another reason for the selection was the fact that the well marked dairy characteristics of the Friesian showed themselves in a remarkable way when grading up cattle with a high percentage of Zebu blood. Friesians are, in addition, easy to handle and very docile, while in the case of the half breds the calves can easily be removed at birth.

### Management of Dairy Herd.

Since the new policy has been adopted no bull is turned out with the herd. When a cow happens to be in oestrum she is brought in, and a record is taken of the service. By this means it was possible to control the calving and regulate the milk supply. The cows are stall fed and an allowance of 3½ lb. of concentrates per gallon of milk is made to each animal. All cows are dried off six to eight weeks before calving, and then "steamed up" for the following lactation period. At the last dairy conference both Messrs. Mackintosh and Boutfloor laid considerable stress on the preparation of dairy cows before calving. This is a point of great importance in the tropics, where, owing to the poor feeding value of the pastures, special efforts should be made to give additional nourishment to cows which are kept on grass up to a day or two before calving. A cow which has not been provided with this extra food will give little or no milk when she calves. This is because she not only has got to provide food for herself, but for a sucking calf and the foetus in utero just before the lactation period starts.

Another advantage has been gained, from the point of running the dairy on the Farm, by having all calves hand reared, a practice which is good for the calf, the cow, the seller and the consumer. A calf reared on the pail is much less likely to suffer from digestive troubles due to over or under feeding which is of a common occurrence when it is given access to the cow's udder. If a calf is allowed to suckle a cow during her lactation period it is likely to get thin milk, followed by the "strippings" which are always rich in butter fat with the result that it often becomes pot bellied, develops a staring coat and eventually dies. A cow which has lost its calf may dry up

and develop trouble with its udder, the nipples of which are very often injured by the calf itself. The seller benefits from hand rearing his calves as the latter need only be fed on whole milk for the first six or eight weeks of their lives. A calf should be allowed a gallon to a gallon and a half of milk per day and to this should be added two or three pints of lime water per week to correct any digestive trouble. The milk should always be fed warm and the animals' mouths thoroughly washed after they have taken their milk. Calves reared in this way can gradually be put on to gruel at six weeks of age. At the Government Farm gruel is made consisting of a mixture of equal parts of rolled oats, corn meal, and oil meal, using one pound of the mixture for every gallon of water. This is thoroughly boiled and then water is added to make the necessary dilution. This gruel costs four cents a gallon and is much cheaper for feeding a calf than a gallon of milk which works out in this Colony from a florin to half a crown in value. The consumer benefits by receiving milk that contains both the "first milk" and the "strippings," the butter fat content of which must be higher than in the case where "first milk" is drawn for sale and the rest, which includes the strippings, given to the calf. It is a recognised fact that in the tropics milk contains a higher butter fat content than it does in temperate regions. Had this not been the case there would be far more prosecutions by the police for milk below the standard in butter fat as nearly all milk supplied in the Colony is from suckled cows.

### Fodder Crops.

It was decided to introduce elephant grass (*Pennisetum purpureum*) as the chief fodder crop in the rainy season and this grass is now planted in all the fields where it grows together with para grass (*Panicum barbinode*). The mixture is an excellent one and the yield per acre from the grass-fields has increased considerably since the new grass has been introduced. Uba cane has been planted to supply fodder for the dry season, and also the bulky food at the end of the dry season when the main sugar crop is over and there is not sufficient rain to ensure a good return of green fodder from the grass fields. During the sugar crop season the fodder is supplied from the tops of good seedling cane, chiefly B.H. 10/12. It was observed eight years ago that the stock on the sugar estates were always in much better condition during the crop season, although they worked harder, a fact which can only be attributed to the fodder available at the time. Cane tops are such an excellent type of fodder that very often the milk yield has been better in March and April than at other times of the year.

### Grading up Cattle.

Since the system of grading up has been adopted the stage has been reached where the three-quarter bred Friesian are now in milk and the results show that an improvement has been achieved in each stage upwards. The work, however, is not confined solely to grading up, as animals of the same grade are bred together. The following grades exist at present in the herd, viz.: half breds obtained by a pure bred sire; half bred, the progeny of half bred parents, and three-quarter bred, the progeny of No. 1 and 2 with a pure bred sire. It is hoped this year to breed together selected three-quarter bred. It has really been wonderful to see what a marked improvement in the dairy qualities of a cow even a half bred Friesian bull can impart. For a number of years both at the Farm and at the public pastures half bred Friesian bulls have been standing for service, and their progeny, cattle with 25 per cent. Friesian blood have been a marked improvement on the ordinary native dairy cow. During the time that this work has been in progress, similar grading up with the Friesian sire has been carried out in India and Ceylon, and the results obtained there are as convincing as they are in this Colony.

In a paper (1) published about the Military Dairies at Lucknow it has been pointed out that the half bred Friesian was a considerable improvement on the common native cow and that the three-quarter bred was an improvement on the half bred while the seventh-eighths bred was still a better animal. The report (2) from Ceylon even stressed the importance of grading up more with the Friesian, for it was said that besides the increased milk yield and the improved dairy characteristics, the half bred and three-quarter bred bulls of this breed were full of bone and made excellent animals for work purposes. Where Jerseys, Guernseys, and Ayrshires are graded up with Indian humped cattle their progeny from a work point of view is more or less useless.

### Results achieved.

The milk yield has been doubled in five years. Whilst in 1923 one hundred cows gave an average production of 5,000 quarts of milk per month, 120 cows are now giving an average production of 12,000 quarts per month. Further, milk is now sold at four cents per gallon cheaper to the public institutions than in 1923 and the revenue from milk sales has risen from $9,000 to $18,000. The revenue from stock has also nearly doubled, and whereas 40 per cent. of the cattle sold at the annual sales had previously been bought by butchers, during the last five years only five of the 150 animals disposed of, have found their way to the Abattoir. A cow recently purchased by a local firm, gave 1,668 lb. of milk in 38 days or an average of 43.9 lb. of milk per day (equal to 26½ bottles), which is probably a record for the West Indies.

(1) Cross breeding and grading of cattle in India by K. W. Founan, B.S.A. (*Journal of the Central Bureau for Animal Husbandry and Dairying in India*, Vol. I, Part 3.)

(2) Dairy Farming and Breeding of Stock in the Kurunegala District by Reginald M. Fernando. (*The Tropical Agriculturist*, Vol. LXX, No. 6.)

## SANT ANTONIO EXPERIMENTAL STATION.

(*See* p. 11.)

*Picking Deltatype Webber Cotton.*

*Cotton No. 105.*

## SANT ANTONIO EXPERIMENTAL STATION.

*Cotton No. 203.*

*Mocó cotton.*

# EXPERIMENTAL ERROR.

## A Survey of Recent Advances in Statistical Method.

(*Continued.*)

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IT was indicated in the preceding section of this survey that the general solution of the problem of field arrangement for plot experiments was the method of randomised blocks, and that the statistical analysis was carried out by means of the analysis of variance. The essential features of the method and its implications will be clearer if we take a particular case and consider the calculations in detail.

### Analysis of an experiment arranged in randomised blocks.

For convenience we may take a relatively small experiment, one in which six varieties are being repeated each four times. First the whole area is divided into four blocks, each of six plots. The varieties A to F are written down on cards and for each block separately the cards are shuffled thoroughly so as to obtain a random arrangement of the six varieties. The arrangement obtained in this instance is shown below, the blocks being numbered I to IV and the varieties A to F.

| | | | |
|---|---|---|---|
| I | B A C<br>F E D | B F D<br>C A E | II |
| III | C B F<br>E A D | D E F<br>A B C | IV |

Instead of considering an actual variety test we will test this field plan on data from a set of 24 plots in a uniformity trial. Filling in on this plan yields from a group of 24 plots (4 × 6) in the Gemmeiza Reliability Test on Cotton carried out by Bailey and Trought (Bull. No. 63, Ministry of Agriculture, Egypt) we obtain results which may be arranged for calculation as below.

| Variety. | Block I. | Block II. | Block III. | Block IV. | Variety Mean ($y_V$). |
|---|---|---|---|---|---|
| A | 34.5 | 33.5 | 26.0 | 27.0 | 30.25 |
| B | 30.5 | 35.0 | 28.0 | 34.0 | 31.875 |
| C | 38.0 | 38.0 | 31.5 | 29.0 | 34.125 |
| D | 36.0 | 36.5 | 25.5 | 31.0 | 32.250 |
| E | 34.5 | 34.0 | 29.5 | 35.0 | 33.250 |
| F | 31.5 | 34.0 | 28.5 | 35.0 | 32.250 |
| Block Mean ($y_B$) | 34.167 | 35.167 | 28.167 | 31.833 | 32.333 = Mean of all = Y |

Having obtained the mean yields for all plots ($Y$), for each variety ($y_V$) and for each block ($y_B$), the statistical analysis may be carried out as follows. The total variation, $Sum\,(y-Y)^2$, may be divided first into variation 'between varieties,' and variation 'within varieties.' The variation within varieties is partly due to yield variation between the four blocks. This block variation affects all varieties alike, since each variety occurs once in each block, and must therefore be subtracted from the total variation between varieties in order to obtain the random or uncontrolled variation.

First obtain the six deviations ($y_V - Y$) of the variety means from the mean of all. The variation between varieties is then four times the sum of the squares of these deviations since there are four plots of each variety. Next calculate the variation within varieties. Obtain the 24 deviations ($y - y_V$) of each plot from the mean yield for its particular variety, square the deviations and sum the squares. The variation due to blocks is calculated by squaring the four deviations ($y_B - Y$) of the block means from the mean of all and multiplying by six since there are six plots in each block. The results are set out below.

| Variation. | Degrees of Freedom. | Sum of Squares. | Variance. |
|---|---|---|---|
| (1) Between varieties.... | 5 | 4 × 8.615 = 34.46 | 6.892 |
| (2) Within varieties.... | 18 | 266.58 | 14.810 |
| (3) Between blocks .... | 3 | 6 × 29.00 = 174.00 | 58.000 |
| (4) Random | 15 | 92.58 | 6.172 |

The sum of squares due to random variation is obtained by subtracting 174.00 (row 3) from 266.58 (row 2). To calculate the variances we divide by the appropriate number of degrees of freedom namely, for variation between the six varieties $6-1=5$, for variation within the four plots for each variety $6\times(4-1)=18$, for variation between the four blocks $4-1=3$ and for the random variation $15=18-3=(4-1)\times(6-1)$. The standard error of the experiment will be the square root of the random variance = $\sqrt{6{\cdot}172}=2{\cdot}484$ and the standard error of comparison of two variety means will be

$$\sqrt{6{\cdot}172 \times 2 \div 4} = 1{\cdot}757.$$

It will be noted that calculation of the variation due to variety is not essential to the calculation of the standard error. It does however, as will be shown later, provide a useful test of the general question, has there been an effect of variety on yield ? and will often be found useful.

# EXPERIMENTAL ERROR

FIGURE 1

Analysis of 6 × 4 Chessboard

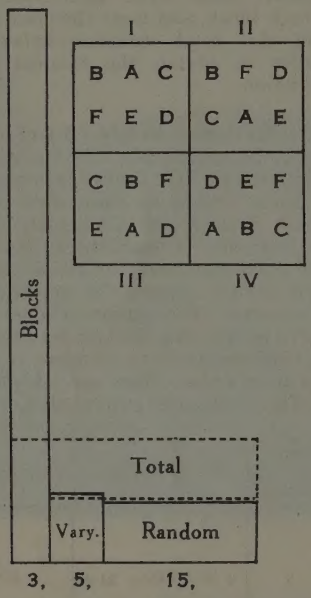



FIGURE 2

Analysis of Latin Square

Potatoes Roth. 1926

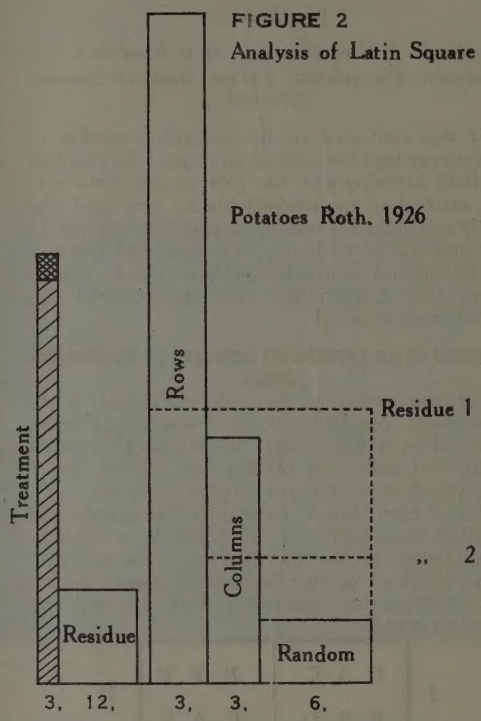
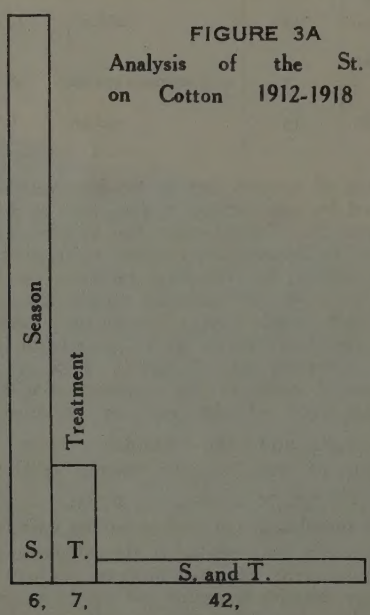
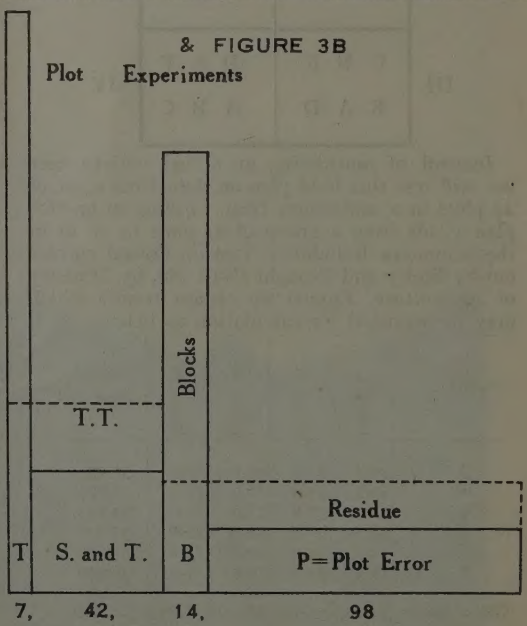



FIGURE 3A & FIGURE 3B

Analysis of the St. Vincent Plot Experiments on Cotton 1912-1918




FOR EXPLANATION OF FIGURES SEE TEXT

In the present case, where there is no real effect of variety, since the data are from a uniformity trial and the varieties are only assumed, it will be noted that the variance due to variety is almost exactly the same as the random variance. The variation between the supposed varieties is of the order to be expected from the random variance. The random arrangement within the blocks has given us a valid estimate of error.

In order to appreciate the method of analysis let us complete the analysis by calculating the total variation (sum of the variation between varieties and within varieties) and re-arrange the data as under.

| | Degrees of Freedom. | Sum of Squares. | Variance. |
|---|---|---|---|
| Total. | 23 | 301.04 | 13.09 |
| Blocks .... .... | 3 | 174.00 | 58.00 |
| Within Blocks .... | 20 | 127.04 | 6.352 |
| Variety .... .... | 5 | 34.46 | 6.892 |
| Random .... .... | 15 | 92.58 | 6.172 |

This analysis is also shown graphically in Figure I (p. 6). The area of each rectangle is proportional to the sum of squares while the base line is proportional to the number of degrees of freedom, so that the height is proportional to the variance. It will be seen that the greater part of the total variation is due to variation between blocks, leaving less than half the total variation to be sub-divided into variation between varieties and random variation. By arranging the varieties at random in each block the total variation within blocks, 127.04, is fairly divided between these two groups. If the varieties had been arranged in the same order in each block it is more than likely that varieties occupying certain positions in the blocks would be favoured at the expense of others. This would not only increase the apparent variation due to variety, but would also correspondingly decrease the estimate of random variation since the sum of squares due to these two causes is fixed (127.04 in this case). The estimated variety differences would be too high and the estimate of error too low. If on the other hand, by some fortunate balanced arrangement of the varieties within the blocks, the variation between varieties were considerably reduced, the estimate of error would be much too high. Both sources of inaccuracy are equally to be avoided. It is, of course, possible to introduce into the plan of the experiment an additional control, concerned with balancing the arrangement of varieties within the blocks: the effect of the additional control must, however, be calculable, and must appear in the statistical analysis in just the same way as does the variation eliminated by means of the blocks. Moreover the residual variation, when all elements of control have been accounted for, must be determined by random causes. The only simple arrangement which secures this further control in a satisfactory manner is the method of the Latin Square an example of which will be discussed shortly. It can be applied only where the number of replications is equal to, or a multiple of, the number of varieties (or treatments) compared. In other cases the random arrangement within blocks must be followed. While this may not produce a perfectly balanced arrangement it does avoid bias and moreover gives an accurate estimate of error.

**Tests of Significance. Application of the Standard Error.**

We noted above that it is possible to make a general test of the results of an experiment by comparing variances. The test in its present form is due to R. A. Fisher who has also provided the tables necessary for carrying out the test. (Table VI Table of $z$ Fisher *loc. cit*). We wish, for example, to know whether the observed variation between varieties is significantly greater than might have been expected from the random variation observed. We divide the variance due to variety by the random variance and obtain, in this case, $\frac{6{\cdot}892}{6{\cdot}172} = 1.116$. We calculate $z$ as half the natural logarithm of this ratio, $z = \frac{1}{2}$ loge $1{\cdot}116 = .0548$. Consulting the table of $z$ we find that a value of $z$ equal to or greater than .533 would occur by chance in 5 per cent. of trials, so that the observed difference in variance is altogether negligible. If, on the other hand, we test whether the variation between blocks is greater than the variation within blocks we find the ratio of the variances is 9.12 and $z = 1.1053$ while the value of $z$ for a 5 per cent. chance is only .566. The variation between blocks is thus far greater than would be expected from random assortment of plots and indicates a real fertility drift, which the arrangement into blocks has eliminated from the comparison of varieties.

For testing the significance of differences between variety means the standard deviation must be employed. When the number of degrees of freedom on which the standard deviation is based is above 30 the table of deviations in the normal distribution may be used. In the present case there were only 15 degrees of freedom and a modified table, *e.g.*: Fisher's table of $t$, must be used. The term $t$ is the ratio of the observed difference to its standard deviation and the table shows the values of $t$ which would be exceeded by chance in one per cent., two per cent., five per cent., 10 per cent., &c., of trials. Often $t$ is calculated for each difference in which we are interested and the probability of that difference estimated. In general, however, the exact probability for each individual difference is immaterial: we wish usually to know what differences we may accept and what should be rejected as not established. For this purpose it is convenient to calculate, from the standard error and the

table of $t$, values, which may be called "*significant differences*," which would be exceeded by chance only once in twenty trials (P=.05) or, if we wish for greater certainty, only once in one hundred trials (P = ·10). In the present case, with 15 degrees of freedom, $t$ for P. 05 is 2.131 and $t$ for P .01 is 2.947. Hence the *significant difference* for *P*. 05 is 2.131 × 1.757=3.744 and, for *P*. 01 2.947 × 1.757=5.177. Using these values as a scale to test the observed series of variety means, we find that, of the 15 possible differences between the six varieties, none reach the higher level of significance and only one, that between the highest and the lowest variety mean ($C-A=$ 3.875), reaches the lower level. If the results obtained in this example had occurred in an actual variety test, we might have concluded that variety *A* (30.25) was almost certainly inferior to variety *C* (34.125). But we should have noted that the variance test (*v. ante*) indicated no significant effect of variety on yield, and the conclusion that *C* was better than *A* would, accordingly, be somewhat tentative. An alternative test, which amounts to much the same thing, is to note whether either *A* or *C* differ significantly from the mean yield for all varieties. The standard deviation for this comparison will be 1.342 (*i.e.* $\sqrt{1+\frac{1}{6}}$ times the standard deviation of a variety mean), and the 'significant difference,' for *P* .05, will be 1.342 × 2.131=2.860. Even the greatest difference, the deficit of *A* from the mean, − 2.083, is well within this limit. There is no sufficient reason, therefore, for thinking that we are dealing with varieties which differ in yield. It is quite true that the difference we observe between *A* and *C* is larger than we should have expected from the magnitude of the standard error; the test applied to this difference is perfectly legitimate. The example may, however, serve to emphasise the need for caution in interpreting yield results. If a number of varieties are being tested the extreme yields will often appear significantly different even when all the varieties have the same yielding capacity. The variety differences to be tested statistically should be decided when planning the experiment rather than after inspection of the data obtained.

The method of analysis illustrated by this 6 × 4 chessboard may be generalised as follows. For $p$ varieties (or treatments) arranged in $n$ blocks, each containing one plot of each variety, where $Y$=mean yield of all plots, $y_V$=mean yield for any variety, $y_B$=mean yield for any block and $y$=yield of a plot, the analysis is

| *Variation.* | *Degrees of freedom.* | *Sum of squares.* |
|---|---|---|
| Total .. .. | $np-1$ | $Sum\ (y-Y)^2=V+R'$ |
| Variety .. .. | $p-1$ | $n \times Sum\ (y_V-Y)^2=V$ |
| Within Varieties .. | $p\ (n-1)$ | $Sum\ Sum\ (y-y_V)^2=R'$ |
| Blocks .. .. | $n-1$ | $p \times Sum\ (y_B-Y)^2=B$ |
| Random .. .. | $(n-1)\ (p-1)$ | $R'-B=R.$ |

The standard error of a variety mean is $\sqrt{(R \div (n\ (n-1)\ (p-1)))}$. It should be noted that in order to estimate the standard error only the two sums of squares $R'$ and $B$ need be calculated. Calculation of $V$ has, however, certain advantages, as illustrated above. It is alternatively possible to calculate the random sum of squares, $R$, directly. A student, using the method for the first time, might find the exercise profitable since it makes clear just what the random variation is. The operation consists in first calculating the *expected yields* for each plot. Take, for example, a plot of variety *A* in block 1. Suppose the mean yield for block 1 is greater than the mean yield for all plots by the amount $x_1$ $(=y_1-Y)$. Then we shall expect the mean yield for the plot of variety *A* in block 1 to be $y_A+x_1$, where $y_A$ is the mean yield for variety *A*. Similarly the expected yield for the plot of variety D in block 2 will be $y_D+x_2$ where $x_2$ is the excess for block 2 over the mean yield for all plots. Expected yields for all plots can be calculated in this way. Now compare the expected yields with the yields observed. There will be differences between the expected and the observed yields, the random sum of squares is just the sum of the squares of these deviations, *i.e.*: it is the variation left when we have taken into account the variation between varieties, as estimated from the variety means, and the variation between blocks, as estimated from the block means.

### The Latin Square.

As we noted above, when the number of replications is equal to the number of treatments or varieties tested an extra element of control can be introduced. The arrangement takes the form of a square with $n$ rows and $n$ columns. Each treatment occurs once in each column and once in each row, thus securing complete equalisation between the varieties so far as concerns position in rows or columns. Apart from these

restrictions the arrangement is determined by random choice. Such an arrangement for a test of five varieties is shown below, as No. 1.

| | | | |
|---|---|---|---|
| | BADCE | | BADCE |
| | ACEDB | | EBADC |
| No. 1. | DBCEA | No. 2 | CEBAD |
| | EDABC | | DCEBA |
| | CEBAD | | ADCEB |

It is important to remember that, apart from the restrictions specified, the arrangement must be random. Arrangement No. 2 fulfills the conditions as to equalisation of rows and columns but it is a systematical arrangement and is not satisfactory. Other systematic arrangements less obviously unsatisfactory are also possible and must be avoided. (The Statistical Department at Rothamsted has prepared a number of Latin Square arrangements which are statistically satisfactory and is prepared to give advice on the use of the method.)

It is not necessary to arrange the plots on the field in the form of a square. Having obtained the Latin Square arrangement the columns or rows of plots may be placed end to end thus, BADCE, ACEDB, DBCEA, EDABC, CEBAD. The plots may be long strips if, for any reason, that shape is desired. (The same re-arrangement can be applied, of course, to the method of randomised blocks.)

The statistical analysis is carried out by subtracting, from the variation within varieties, the variation due to rows and to columns, or, in the case of the sequence given just above, the variation due to blocks and to position in blocks. As a simple example we may take a Manurial Experiment on potatoes at Rothamsted in 1926. The data are taken from the Annual Report for 1926. There were four treatments—No potash (*O*) Sulphate of Potash (*S*), Muriate of Potash (*M*) and Potash Manure Salts (*P*). The arrangement was

| | | | | | |
|---|---|---|---|---|---|
| Rows | I | M | S | O | P |
| | II | S | P | M | O |
| | III | P | O | S | M |
| | IV | O | M | P | S |
| Columns | | 1. | 2 | 3 | 4 |

The mean yields were

| *Treatments.* | | *Rows.* | | *Columns.* | | *Mean of all* =484.9 | |
|---|---|---|---|---|---|---|---|
| *O* 423.3 | .. | I | 525.3 | 1. | 510.5 | *Sum* $d^2$ Treatment | =5,379.7 |
| *P* 491.4 | .. | II | 467.8 | 2. | 483.0 | ,, $d^2$ Rows | =3,016.2 |
| *M* 515.9 | .. | III | 453.0 | 3. | 478.3 | ,, $d^2$ Columns | = 995.0 |
| *S* 509.0 | .. | IV | 493.5 | 4. | 467.8 | | |

The first step, as in the previous case, is to obtain the variation due to treatment and the variation within treatments. The latter is, of course, the sum of squares of the deviations of each plot from the mean for its treatment. We may call this the 'first residue.' The result is shown in the table below and also graphically on the left of figure 2, where the 15 degrees of freedom available from the 16 plots are shown divided into three for the effect of treatment and 12 for the residue. As in figure 1 the height of the rectangle is proportional to the variance and the area to the sum of squares.

| *Degrees of freedom.* | | *Sum of squares.* | *Variance.* |
|---|---|---|---|
| Treatment .. | 3 | 4 × 5,379.7 =21,518.8 | 7,172.9 |
| 1st Residue .. | 12 | 18,109.0 | 1,509.1 |
| Rows .. | 3 | 4 × 3,016.21 =12,064.8 | 4,021.6 |
| 2nd Residue .. | 9=(12−3) | 18,109 −12,064.8 = 6,044.2 | 671.6 |
| Columns .. | 3 | 4 × 995.0 = 3,980.0 | 1,326.7 |
| Random .. | 6=(9−3) | 6,044.2 − 3,980.0 = 2,064.2 | 344.03 |

Variance of mean yield for a treatment = 344.03 ÷ 4 = 86.01
Standard deviation of difference between mean yields = $\sqrt{2} \times 86.01$
= 13.15

The 'first residue' though small compared with the treatment variation, includes a considerable part due to the variation between the rows and between the columns. On the right of figure 2 is shown graphically the analysis of this residue. The scale is increased three times to make the analysis clear. Subtracting the large sum of squares due to rows we obtain a 'second residue' with a much smaller variance. Subtracting from the 'second residue' the sum of squares due to columns we have a final residue, the random variation, which has a still smaller variance. It should be noted that, as we progressively reduce the sum of squares by subtracting the contributions of rows and of columns, so also we reduce the number of degrees of freedom by the numbers contributed by rows and columns respectively. In consequence the random variance is reduced only when the variance due to rows or columns is greater than the variance of the residue.

The manurial results may now be examined. We might just calculate the 'significant difference' and note what manurial differences are definitely established. It is more instructive, however, following a method developed by Fisher, to consider what questions the experiment is designed to test, and examine each in turn. There are four treatments, with three degrees of freedom; consequently the results can be summed up in the answers to three questions. There is first the main question, has there been any general effect of potash manuring? Secondly, does the effect of potash manure salts differ from the mean effect of the relatively pure fertilisers, sulphate and muriate of potash? Thirdly, is there any difference between sulphate and muriate? The test of these three questions is set out below.

| | *Mean Difference.* | *Standard Deviation.* |
|---|---|---|
| 1. Potash *versus* No Potash .. .. | $\frac{1}{3}(S+M+P)-O=82.13$ | $\sqrt{\frac{86.01}{3}+\frac{86.01}{1}}=10.71$ |
| 2. Pure fertilisers *versus* Potash manure salts | $\frac{1}{2}(S+M)\quad -P=21.05$ | $\sqrt{\frac{86.01}{2}+\frac{86.01}{1}}=11.36$ |
| 3. Muriate *versus* sulphate .. .. | $M-S\quad =6.90$ | $\sqrt{86.01+86.01}=13.15$ |

Note that (1) the standard deviation is lower for the more general questions, since we are comparing not one treatment with another but one treatment with the mean of two or three. (The derivation of the variance and standard deviation of comparison from the variance for one treatment (86.01) will be obvious from the table.) (2) The main questions are consequently determined with greater accuracy.

The main effect, response to potash, is obviously significant, the difference being 7.67 times its standard error. The third difference, Muriate minus Sulphate, is clearly negligible, being less than its standard error. Sulphate and muriate are, on the average, superior to potash manure salts and since the difference is greater than its standard error it may be tested. The ratio $t$, (Difference ÷Standard error) is 1.853. For six degrees of freedom we find, from a table of $t$, that $t$ must be 2.365 for a probability of five per cent. and 1.895 for a probability of ten per cent. The difference, though suggestive, is thus not definitely established. It might have occurred by chance in rather more than ten trials out of 100.

### The Effect of Season and Place.

The types of field plan discussed above provide accurate methods of testing yield differences in one place in any season. Naturally the conclusions apply only to the particular seasonal or soil conditions of the experiment, for they are tested only against the standard error due to differences between adjacent plots in that season. If we require conclusions valid over a range of seasons or places, we must carry out a series of experiments, and test the mean differences against a standard error which includes the differential variation due to season or place. If only general conclusions are required we can, theoretically, dispense with the estimate of field error, since the standard error calculated for the whole series will include the field errors, together with the errors due to differential response in different seasons. Replication of field plots may therefore, in such cases, be somewhat reduced, but it is always desirable to retain some replication so that an estimate of field error shall be possible. For example, suppose the net standard error due to season is 10 per cent. of the mean yield then if the standard error due to field differences is only five per cent. the total error is only $\sqrt{10^2+5^2}=11.18$ per cent., and so far as general conclusions are concerned the experiment would be very little improved if the field error were reduced by further replication. If on the other hand the field error were as much as 20 per cent. the total error would be $\sqrt{10^2+20^2}=22.36$ per cent. and the accuracy would be greatly improved by further replication. Again

even in a wide range experiment, aimed at securing general results, it is an advantage if we can test whether widely different results obtained in, for example, a wet and a dry season are really due to the season; and this test can only be carried out if we know the field error.

The analysis of a set of results for several seasons is illustrated graphically in figure 3. The case taken is the seven years series of manurial experiments on cotton in St. Vincent. There were eight manurial treatments, arranged in three blocks, one plot of each treatment in each block, *i.e.*: 24 plots each year or 164 in all. The analysis may be carried out in two stages. First we take the 56 mean yields for the eight treatments in each of the seven years. (Figure 3A.) From the mean yields for all treatments in each year (=yearly means) and the mean yields for each treatment over all the years (=treatment means) we calculate the sum of squares due to treatment (seven degrees of freedom) that due to years (six degrees of freedom) and are left with a residue, obtained by subtraction from the total sum of squares, due to differential response of treatment in different years. The standard error, for testing whether there is any consistent effect of treatment over the seven years, is the square root of this residual variance. In Figure 3 the height of the blocks represents the variance, and the base the degrees of freedom: $S$ is average seasonal variation, $T$ is average treatment variation and $S+T$ is the differential response. It will be noted that the effect of season far exceeds the effect of treatment and that both are much greater than the differential response.

The further analysis, which takes account of the field variation between plots in the same year, is shewn in figure 3B. The vertical scale is five times that for Figure 3A. The total variation between replicates has $112=2 \times 56$ degrees of freedom since there are three plots for each of the 56 mean yields for treatments. From the sum of squares of the deviations of these replicates from their means (=Residue, Figure 3B), we subtract the sum of squares due to the variation of the block means from the mean yields for each year ($B$ in figure 3B) and obtain the variance due to field differences between adjacent plots Plot Error or $P$ in Figure 3B). It will be noted that the variation due to blocks is considerable, and much greater than the variation due to differential response of treatments in different seasons. Elimination of the block variation considerably reduces the estimate of plot error, but it will be seen that this variation is still appreciable compared with the differential response. Consequently only relatively large differences in response to particular treatments in different years would be detected with any accuracy.

(*To be continued.*)

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**The Editor will be pleased to send a gratuitous specimen copy of *Tropical Agriculture*, post free, to anyone interested in tropical development.**

## CEARA COTTON SERVICE.

We are very much indebted to the Director of the Cotton Service, State of Ceara, Brazil. for the photographs appearing on pp. xi-xiii. These were received with his Report on the Service's activities which have been mainly confined to organising research work in the selection and propagation of pure varieties of cotton seed. The principal experimental station is at Sant Antonio but seed farms and demonstration plots have also been started in the interior of the State. The Service is also responsible for the registration of gins, the collection of cotton statistics, and the carrying out of manurial experiments.

At Sant Antonio, an area of 40 hectares (approximately 100 acres) is being farmed on experimental lines and has been planted chiefly under cotton, the most successful varieties grown so far being Moco, No. 105, No. 203, and Delta-type-Webber. Maize, rice and beans are also cultivated, the latter as a green manuring crop.

The 1927 cotton yields were adversely affected by heavy rains which damaged the seedlings and by very dry weather which caused a large percentage of the young bolls to drop off. Much damage was also done by the following insect pests:

(1) *Gasterocercodes gossypii*, "broca," attacks root and stem of plant.

(2) *Alabama argillacea*, "curuquerê," (cotton worm), attacks leaves.

(3) *Gelechia gossypiella*, "lagartar osada," (Pink bollworm), attacks boll.

(4) *Oxycarenus hyalinipennis*, "percevejo," attacks seeds.

Manurial experiments have been confined to testing the effect of applying increasing quantities of nitrate of soda and comparing results with untreated plots. Superphosphate and chlorate of potash were also tried.

The construction of the main irrigation canal, part of which is shown on page xiii has almost been completed while a building has also been erected for housing a cotton press and an engine for driving the cotton gins.

The most important work of the station has been the carrying out of variety tests experiments, the cottons tested including three perennial varieties common to South America, three pure types from North America, four Egyptian and Pima types and sixteen selections made in 1924 from individual plants grown from local seed. As these experiments have not been proceeding very long no conclusions have yet been reached as to the respective value of the varieties tried, although figures which may lead to interesting results have already been collected.

Two seed farms comprising an area of about 1,500 acres have also been established, while the use of modern implements has been demonstrated on certain of the experimental plots which were started in the interior of the State.

G. G.

# WORLD TOBACCO.

## Brief History and Economic Review—(*Concluded*).

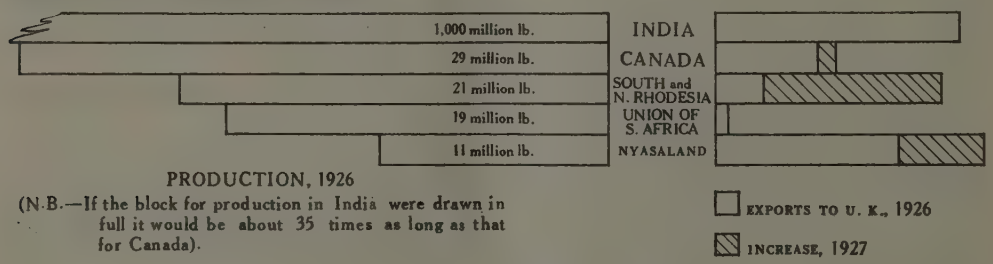
By G. Wright, M.Com.
*Lecturer in Economics.*

### Tobacco Production within the Empire.

Before the war the demand for tobacco on many occasions tended to outrun the supply and the scarcity was aggravated by formation of pools among planters. In Great Britain the Imperial Tobacco Company turned its attention to the advisability of extending sources of supply and experiments were conducted in Nyasaland and elsewhere. The movement was aided by a strong sentiment in favour of increasing trade within the Empire, and tobacco cultivation has been encouraged for the past several years in order to render the United Kingdom more independent of outside purchases. As an inducement to importers, Empire tobacco was granted a rebate of one-sixth of the United Kingdom import duty in September, 1919. In July, 1925, in response to representations of the British Empire Producers Organisation, (9) the rebate was increased by 50 per cent. to one-quarter of the full rate, or to 2*s.* $0\frac{5}{8}$*d.* a lb. and by the Finance Act of the following year the preference was established at this figure for 10 years from the 1st July, 1926. The effect on production was considerable especially in those parts of the Empire which have a surplus for sale in the United Kingdom and the proportion of imports of tobacco from the Empire rose from 3 per cent. in 1921 to 18 per cent. in 1927. In judging the effect of the preference in different countries it is necessary to refer to the conditions of the trade. The heavy crop of India is largely consumed locally, and variations in the total are great, so that it is difficult to ascribe the increase that took place to the effect of the preference. In Canada, where there is a considerable surplus for export, the 1926 production was double that of 1918. In the same period production more than quadrupled in Nyasaland and Northern Rhodesia and it increased by thirty times in Southern Rhodesia.

The relation of Empire production to that elsewhere has already been discussed and the statistical position was given in Table I. The diagram below illustrates the relative positions of the different parts of the Empire as producers and as sources of supply to the United Kingdom.

**TOBACCO IN THE EMPIRE, 1926.**




### India. (10)

After the introduction of the tobacco plant into India by the Portuguese more than 300 years ago, extension took place rapidly, and at present over one million acres are under cultivation. The reliability of total production figures is questionable, but in 1926 the production was put down at 1,000 million lb.—about 20 per cent. of the world production.

The circumstances under which tobacco is grown, cured and marketed in India will always make competition with America a matter of great difficulty. The small holder cannot afford even the simplest curing barn, and as the whole of the crop rarely ripens at one time there is a lack of uniformity in the product. The cultivators pay little attention to evenness, colour and texture, but everything is done to secure maximum weight, consequently the coarse kinds usually predominate.

#### Consumption.

Sixty to seventy per cent. of Indian tobacco is made up locally into "biri-biri" cigarettes, cheroots, and a paste composed of tobacco, molasses, opium leaves, &c., which is smoked in the *hookah* pipe. Cigarettes, however, are now replacing the *hookah* and a number of factories have been established to supply the growing demand.

#### Trade.

*Exports.*—Prior to the war exports were about 20 million lb. There was an increase during the war years and the peak was reached in 1919 (35,464,000 lb.). After that came a decline and in 1922 exports were slightly below the pre-war average. It will be observed that only a small part of the production is exported and the export surplus is variable. The United Kingdom has been buying larger quantities in accordance with her colonial policy, but these quantities vary greatly—3.9 million lb., 1921; 11.9 million lb., 1926; 8.4 million lb., 1927.

*Imports.*—Cigarettes constitute the bulk of the imports of all tobacco (about six million lb.) and the United Kingdom supplies on average over 80 per cent. of these.

### Canada.

The crop is important in only two provinces, Ontario and Quebec. Before the war, normal production was 10 to 12 million lb. It declined during the war but later increased in 1920 to a record crop of 48 million lb. In 1926, 29 million lb. were produced.

### Union of South Africa. (11)

PRODUCTION.

The principal tobacco districts are the Magaliesberg and Kat River districts, which produce a light and medium tobacco of the Virginian type; the Potchefstroom, Vredefort, Piet Retief, Oudtshoorn, and Piquetberg districts which produce a medium to heavy type; the Stellenbosch, Wellington and Tulbagh districts which produce Turkish tobacco; and Natal, in which province a medium dark type, largely consumed in the manufacture of cigars, cheroots, and a cheap grade of pipe tobacco, is produced. Between 1918 and 1926 production increased 1¼ times and present production is in the neighbourhood of 19 million lb. The recent revision of the fiscal and co-operative laws has undoubtedly stimulated cultivation.

CONSUMPTION.

At one time a fairly large percentage of the crop was put up by farmers into roll tobacco, the rolls being converted into pipe or snuff tobacco by the consumer and there is still a considerable quantity of roll produced both by farmers and by factories, but of recent years there has been an increasing demand for leaf of light or medium colour and finer medium texture. Cigarettes from local Turkish have become popular and the production of leaf has become fairly established. At present about 11 million pounds of the 19 millions produced are consumed locally.

### Australia.

PRODUCTION.

Although largely a consuming country—15 to 20 million lb. of leaf and over one millionlb. of manufactured tobacco is imported—Australia produces about 1.5 million lb. The industry has experienced marked fluctuations. At one time it promised to occupy an important place amongst the agricultural industries but "blue mould" disease and lack of knowledge of proper curing have limited cultivation. Production in 1926 stood at 1.5 million lb., but between 1909-1922, variation took place from 380,955 lb. (1916-17) to 2,827,400 lb. (1913-14).

The soil and climate of New South Wales, Victoria and Queensland are well suited to cultivation, but the "blue mould" which appears in seed beds before tobacco can be transplanted to the fields has made growing unprofitable. The tobacco hitherto produced has not possessed the pleasant aroma that appeals to smokers nor has it been of the type demanded by the consumer in Australia. Until therefore, the aroma, quality and type can be improved, it does not appear likely that the demand for it will be great and large quantities of American tobacco will have to continue to be imported. To further the domestic production, the Commonwealth Government and the British Australian Tobacco Company agreed jointly to set aside £30,000 a year for three years for investigation and field testing, the sum to be raised to £60,000 a year for another three years if there be sufficient progress. To control the investigations a Tobacco Investigation Committee was formed and in August and September, 1927, Dr. Darnell-Smith (12) visited America to survey the flue-cured tobacco industry.

CONSUMPTION AND IMPORTS.

Imports of leaf vary from 15 to 20 million lb., 95 per cent. of this coming from the United States. Imports of manufactured tobacco are small and total about one million lb. annually. About a quarter of the consumption is in the form of cigarettes and two-thirds in the form of pipe tobacco.

### Production in Rhodesia and Nyasaland.

Southern Rhodesia which includes Matabeleland and lies south of the Zambesi River, is a British self-governing Dominion and has a population of about 40,000 Europeans among a native population of about twenty times that number. Northern Rhodesia, which extends to the Belgian Congo and reaches Lake Tanganyika, is administered by the British Government, and has scarcely 4,000 white people to about one million natives. Nyasaland, a Protectorate, lies between Rhodesia and Lake Nyasa and has a southward extension on either side of the Shire River. The three areas lie entirely within the tropics but the elevation of much of the country renders the climate suitable for European occupation. Geographically, they belong to the southern and eastern savannah division of the tableland of Africa, and, although vegetation is likely to be burnt up during the season of drought, the rainfall everywhere is over 30 inches.

Primitive agriculture and pastoral work are the chief occupations of the population which is almost entirely native, but large crops of tobacco are grown by European settlers. An idea of the development of production can be got from the following figures:

| | Production in thousands of lbs. from crops sown in | | Increase in thousands of lbs. | Crop of 1926 as compared with that of 1918. |
|---|---|---|---|---|
| | 1918 | 1926 | | |
| Southern Rhodesia .. | 620 | 19,175 | 18,555 | 30 times |
| Northern Rhodesia .. | 445 | 2,071 | 1,626 | 4½ do. |
| Nyasaland .. | 2,594 | 10,978 | 8,384 | 4¼ do. |

—From *9th Report of the Imperial Economic Committee.*

The tobacco crop in these areas is of such importance relatively to all other agricultural produce that its fate each year has profound reactions on the general prosperity of the country. Furthermore the crop has a political value—the Report of the Imperial Economic Committee states that the speed at which settlement can be effected is in close relation to the success attained in producing tobacco to the liking of the British public.

### Southern Rhodesia.

Tobacco was taken up seriously about 1910 and in 1913-14, 5,627 acres were under cultivation, over three million lb. being produced. The war period caused a reduction in acreage and production, but afterwards an increase took place, stimulated later by the preference.

Some 75 per cent. of the tobacco is suitable for cigarettes, the leaf grown being mainly Hickory Prior—a fine bright leaf.

The plant thrives best in sandy and loam soils and in Southern Rhodesia the geological formations are such that 75 per cent. of the soils are predominantly sandy, the area of the colony is 152,000 square miles hence the whole area of land suitable for tobacco growing is enormous. Of the area made up of sandy soils, 55.4 per cent. has a rainfall which is ample for the production of tobacco. The rainfall is usually lighter in the Western portion of the colony than in the eastern section, and as Turkish tobacco requires less moisture and more sunshine than Virginian, Matabeleland is regarded as being more suitable for Turkish, while Virginia tobacco is more extensively grown in Mashonaland.

Up to 1924 practically the whole output was bought on a two-year contract basis by large manufacturers in South Africa, who could now take about four to five million lb. As a result of the Wembley Exhibition, however, eager buyers appeared in Rhodesia. The Tobacco Warehouse and Export Company, Ltd., a co-operative society representing the growers—dropped the long contracts and diverted the whole surplus produce to the London Market. Better prices were got—average 1921-23, 8½*d.* a lb.; 1924-25, 13¾*d.* a lb.; 1925-26, 16⅔*d.* a lb. and production was extended, but, with a limited leaf market in England, a considerable proportion of the 1927 crop remained in the hands of producers. Manufacturers could not suddenly alter their arrangements and utilise a large supply of tobacco which suddenly fell on an unprepared market.

### Northern Rhodesia.

The amount obtained from tobacco (1926, £155,832) exceeds that from any other crop exported (maize and maize meal £41,812; wheat £18,575). Transport is a difficulty and the tobacco has to be carried 300 miles by road to the railhead in Nyasaland, at a cost of 3*d.* per lb.

Sir Harry Wilson, K.C.M.G., K.B.E., recently stated: (13) "It is now something like fourteen years, or perhaps it may be a little longer, since we began to grow tobacco in North Charterland. At that time there was none grown there at all, and our attention up to that time had been given to the growing of cotton. But as soon as there was a chance of preference coming into being, we turned our attention, and our settlers, who were there in large numbers, also turned their attention to the growing of tobacco; and from a perfectly negligible output at the time I have referred to, down to the present day, the amount has increased so that it is now in the neighbourhood of 2,000,000 lb. (14) per annum. It has been done under very great difficulties, in a very out-of-the-way part of the country, and with extraordinary trouble as regards transport. We first of all came down to the river at Tete with the old fashioned South African wagons and oxen, and we used to find the road eaten out by the number of oxen who travelled it, and we used to get our oxen devoured by lions on the way, and when we got out stuff down to Tete we had to transport it a very long way down the river to the port which then existed, called Chindi, and from there by smaller vessels on to Beira. The ox wagon came to an end as a means of transport, partly because the country in several districts of it was infested with tsetse fly, and it became necessary for us to change from our policy of wagon transport to motor transport, and that is what we employ now. We no longer go to Tete, but we go to the railhead, and from there we transport the stuff down to Beira by rail. The Port of Chindi having disappeared in a hurricane, and the railway having now been constructed, our route is now by rail with the exception of the unfortunate intervening space where the Zambesi bridge is so much needed."

### Nyasaland.

Tobacco first figured among the exports in 1893. In 1905 the acreage was only 421, but in 1913 it had reached 10,496 acres, 3,763,414 lb. being exported. The Imperial Tobacco Company, which set up a factory in 1908 helped materially to develop the industry. Recent extension of production can be seen from the following export figures:—

| Date. | 1923. | 1925. | 1926. | 1927. |
|---|---|---|---|---|
| Tobacco exported million lb. .. | 5 | 7 | 9 | 15 |
| Percentage of total value of exports .. | 48.03 | 49.61 | 61.35 | 80 |

The industry has quickly expanded but unfortunately the quality of the product has not improved greatly. Mr. Hornsby, Agricultural Chemist in charge of Tobacco Investigations states (15) that "tobacco culture in Nyasaland is not yet the highly specialised industry that it is in the United States. The methods of some growers approximate to those of the early settlers of Virginia. It is necessary in the future that more intensive methods should be used, which will require a wider knowledge of the science of tobacco culture, especially the chemistry of

soils and manuring, rotations and the work done by the organised and unorganised ferments as exemplified by the bacteria of leaf spot and the enzymes operative in curing." He gives no special attention to economic problems and dismisses the question of co-operation as follows, "Growers with long experience and extensive knowledge do not want their tobacco pooled with that of some newcomer who is growing his tobacco for the first time this year, probably on unsuitable soils or under unsuitable climatic conditions."

Production is not confined to estates. In 1927, Europeans produced 4,682 tons or 57.34 per cent. of the total and natives produced 3,454 tons or 42.66 per cent. of the whole crop. The leaf consists partly of bright tobacco, but more of mottled or dark tobacco, similar in some respects to Kentucky and used mainly in the manufacture of pipe tobaccos. The proportion of leaf suitable for cigarettes is perhaps 15 per cent. as against 85 per cent. suitable for pipe tobaccos.

### British North Borneo.

This territory lies within the equatorial forest region (temperature 70°-90°F. rainfall 80-120 ins.) has an area of 29,184 square miles (equal to Scotland), and a population of 257,804 (1921) including 415 Europeans and 37,500 Chinese. The greater part of the country is at present covered with jungle but the soil is found to be well adapted for the growth of almost all tropical products, more particularly rubber, tobacco, coconuts, sugar, coffee, sago, tapioca and pepper.

Most of the natives of Borneo are smokers and they grew their own tobacco long before the special variety used for cigar wrappers was introduced by Europeans (1883). For sometime after this introduction North Borneo seemed likely to be a formidable rival of Sumatra, but owing to lack of knowledge of tobacco cultivation and selection of land, some of the plantation companies had a brief existence. "One estate was established in a district peopled by head hunting natives then unschooled to government by Europeans, and where the crop and all supplies had to be carried over twenty miles of unroaded hills."([16]) The position in recent years has been as follows :—

TOBACCO, 1925-27.

| | Value of total exports (1) | Imports into the U. K. | |
|---|---|---|---|
| | | Value. | Quantity. (2) |
| | £ | £ | lb. |
| 1925 | 145,154 | 156,000 | 830,000 |
| 1926 | 136,014 | 165,000 | 895,000 |
| 1927 | 189,574 | 248,000 | 1,302,000 |

(1) Progress Report, British North Borneo (Chartered) Co. for 1927.

(2) Ninth Report Imperial Economic Committee. The differences in value are presumably due to freight, insurance, &c.

The quality of the leaf has lately been so improved that, with the help of the preference, it has displaced its rival Sumatran leaf to a large extent in the "wrapper trade" in the United Kingdom. In 1927 the direct imports of cigar leaf from British North Borneo were estimated to have satisfied half the total demand of cigar manufacturers in the United Kingdom. The only Empire sources other than Borneo from which cigar leaf is imported into Great Britain even to a small extent are Jamaica and Canada.

### General position of Empire tobaccos and their future.

"With the exception of the Cyprus, the Borneo and most of the Indian tobaccos, the Empire tobacco imported into the United Kingdom is of the American type grown from acclimatised American seed. Hitherto, however, most of the tobacco imported from the Empire has been of the darker variety suited for pipes and only in the last two years have cigarette tobaccos become available. It may be taken that, at present, the imports from Canada, India, the Union of South Africa, and about 85 per cent. of the tobacco from Nyasaland consist of pipe tobacco. Some 15 per cent. of the imports from Nyasaland and 75 per cent. of those from Rhodesia are of the cigarette type" (§ 30). Empire pipe tobacco has met with success, but while 37 per cent. of the pipe tobacco used in the United Kingdom comes from the Empire, only 1 per cent. of the cigarette tobacco comes from the same source. At present about 58 per cent. of the tobacco consumed in the United Kingdom is in the form of cigarette, and in view of the recent remarkable development of the cigarette habit, the relative failure of the Empire to cater for this demand is unfortunate.

Type and quality is of special importance in cigarette tobaccos and American experience is a strong factor in competition. Fashions, however, change, and if the Empire producer can market a cigarette tobacco which does not do violence to established tastes, a sound footing on the market should be obtained.

Production has reached such a scale that some organisation and co-ordination of effort is necessary to deal with two problems—the improvement and maintenance of quality, and the improvement of the technique of marketing.

*Quality.*

A good deal of work has been done by local agricultural departments and this is being extended by other institutions. The Imperial Economic Committee suggests further investigations on the effects of soil, climate, manuring and curing on flavour; the soil mapping of tobacco areas, and investigations into the chemical and biological causes of aroma. "In view of

the acknowledged complexity of the problems involved, this subject appears to us to be one well suited for centralised research. At the same time, where so little has yet been done in the way of defining the questions to be addressed to nature we hesitate to recommend to the Empire Marketing Board any considerable expenditure, until preliminary investigation has made clear the lines of attack. We think, however, that a comparatively small expenditure of money on a few carefully considered investigations might show the necessity for further expenditure on fundamental research" (§ 56.)

*Marketing.*

To improve methods of marketing—by regularising supply, establishing grades, and stimulating demand—producers' organisations are recommended (§ 64), but where this is not practicable, *e.g.*: in the smaller colonies like Nyasaland and Rhodesia—open selling floors as in America, are mooted, the profit of the markets to be devoted to the improvement of equipment and staff. Rhodesian and Nyasaland tobaccos are packed in bales of 220 lb. while American tobacco is packed in wooden hogsheads each containing 800 lb. To a large extent this is due to the absence of suitable timber and difficulties of transport, but in view of the fact that manufacturers prefer the hogsheads, producers are advised to devise methods for more effectively protecting their leaf from damage. (§ 44.)

*Stimulation of Demand.*

Of the two methods, lower prices or better value at a competitive price, the Committee favours the second. "Brands of Empire cigarettes are being placed upon the market at retail prices similar to those for established brands and leaving to the retailers equal margins. An advantage is given to the consumer by supplying him with a cigarette larger in size. We believe that this is a wiser policy than attempting to capture the market by drastic price reductions." (§ 73.) Governments and producers' organisations are already advertising their products in the United Kingdom and it is suggested that the Empire Marketing Board, which is developing in the direction of stimulating demand for definite Empire products, should regard tobacco as a special opportunity for doing this. The over production that has occurred in Africa points to the need for information on the trade being transmitted to producers and while deprecating any attempt to dictate the quantity of production or the varieties of tobacco to be grown in any part of the Empire the Committee suggests that the Empire Marketing Board set up a Tobacco Information Committee which should arrange for the interchange of information. A publication on the lines of the weekly circular issued by the Tobacco Section of the Department of Commerce in Washington is also suggested.

*Empire Producers' Organisation.*

The Tobacco Committee of the Empire Producers' Organisation has already been mentioned. This organisation now contemplates the formation of an Empire Tobacco Federation on the lines of its Sugar Federation. The functions of the Committee "would include the maintenance of constant contact with Parliament—to ensure the continuance of the principle of preference; the education of the electorate in regard to the reciprocal value of such preference to the English manufacturer; the establishment of a clearing house for information about the tobacco industry and market; and co-operation with the Empire Marketing Board on matters of propaganda and scientific research." ([17].)

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REFERENCES.

(9) Mr. Ponsonby in a paper recently read before the British Empire Producers' Organisation states: "In 1919 that organisation (the Tobacco Section of the British Empire Producers' Organisation) was largely responsible for obtaining the first preference on Tobacco. In 1923 the Tobacco Committee as representing the whole Empire industry, carried on the negotiations with the Imperial Conference and the Government, which led to the increase and stabilisation of the preference."

(10) From Howard, *Crop Production in India.* Oxford University Press, 1924 and U.S. Department of Commerce *op. cit.*

(11) From Official Year-book, No. 8 *and* Leppan and Bosman, *Field crops in South Africa.*

(12) Some of his results will be found in a paper "The Production of Bright Flue Cured Tobacco in America." *Jrnl. Council Scientific and Industrial Research, Australia*, 1, 3, pp. 143-153.

(13) In the discussion of Mr. Ponsonby's paper.

(14) 1927, 3,005,798 lb., 2,777,152 of this in the Fort Jameson district.—*Ann Rept., Dept of Agric.*

(15) In a report "*Tobacco Culture: a comparison of methods adopted in the United States and in Nyasaland.*"

(16) *Handbook of the State of British North Borneo*, 1921.

(17) Mr. Ponsonby, *op. cit.*

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**ERRATA.**

In December issue, page 313, Table II, for value in £ sterling read value in £1,000 sterling.

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## ENGLISH BANANAS.

Recently attempts have been made in Chelmsford to grow bananas on a commercial scale under glass, but in these days of rapid transport the cost of home production of the fruit is likely to be too high to make the proposition a remunerative one. The flavour of the English fruit is said to be better than that of the imported which could be improved if it could be shipped ripe instead of green as is now done. Artificial methods which would preserve the ripe fruit from deterioration during transport have not yet been devised although artificial methods of ripening are known to exist, and recent experiments have shown that the application of ethylene gas in very small doses speeds up ripening.

# RUBBER CULTIVATION.

## Cover Crops and Green Manuring.

[*The following article by Mr. J. Mitchell,* A.R.C.SC., *Organising Secretary, Rubber Research Scheme (Ceylon), is reprinted from "The Tropical Agriculturist," Vol. LXX, No. 5. It gives an excellent summary of the benefits accruing from the use of both cover crops and green manuring. Although the article is written from the point of view of rubber cultivation, the facts apply equally to any crop. The type of cover crop used is of course regulated by the nature of the main crop. In the case of annual crops in particular, a further advantage of growing a cover crop during a fallow period or during the initial stages of the main crop is that the necessity of weeding is practically removed.*]

### 1. Cover Plants.

(*a*) *For the Prevention of Soil Erosion.*—There can be little doubt that the primary purpose of growing cover plants in rubber cultivation is to prevent soil erosion. As soon as the land is cleared from jungle it becomes exposed to the baking action of the tropical sun and to the scouring action of the tropical rains. Under the system of clean weeding which has been practised on practically every rubber estate in Ceylon this condition has been maintained throughout and everywhere one now sees the effects of this policy. The rubber trees were allowed undisputed tenancy of the soil with the result that they now have the undisputed tenancy of the subsoil while all the soil has been removed to the paddy fields and rivers below. In other words, if rubber is grown under conditions of clean weeding the top soil is, in a few years from the time the jungle is felled, practically certain to be lost. Before considering the means for preventing this loss it might be well to ask why one should be anxious to preserve this top soil. Everyone realises in a vague sort of way that the top soil is valuable, but it does not appear to be fully appreciated how vitally its retention affects the continued fertility of the soil and the general well being of the rubber grown thereon.

The top soil handed to us after the jungle growth is cleared consists of finely divided particles of mineral matter and of the accumulated remains of dead animals and plants (humus), and is inhabited by a vast population of micro-organisms (soil bacteria). These bacteria are constantly at work breaking down complex nitrogenous compounds in the soil leading to the formation of soluble nitrates which are immediately available as plant food for the rubber. The continued activity of these micro-organisms, however, depends on there being a sufficiency of humus and of water in the soil and everything possible should be done to ensure that these conditions are present. That is, this layer of soil is not merely a dead stratum overlying the subsoil but is an active medium providing the source of all present and future fertility.

If left exposed the direct action of rain water quickly removes this layer of soil and there is a steady depletion of the raw and manufactured materials necessary for the sustenance of the rubber. In addition, the removal of top soil involves the removal of the micro-organisms which play such an important part in creating fertility.

Certain mechanical means such as platform terraces, stone terraces, and silt-pits have been employed, each of which are valuable for the prevention of soil erosion, but none of these fulfil all the conditions necessary to ensure the continued fertility of a soil. It should be our purpose not only to prevent the removal of the soil but to maintain the humus content and to stimulate the activities of the various micro-organisms therein. This can only be done by the establishment of a suitable cover plant. Those which have shown the best results in Ceylon are *Vigna* (*Dolichos Hosei*), *Centrosema pubescens* and *Centrosema Plumieri*. These are creeping plants which, in course of time, form a close carpet over the ground and completely protect it from the direct action of the sun and of the rain and thereby reduce soil erosion to a minimum.

(*b*) *For Improving the Physical Condition of Soils.*—We have seen that a cover plant serves the purpose of retaining top soil by screening it from the direct action of the sun and rain, but that is not the only function it performs. The penetration of the roots of cover plants serves to break up hard soils and clays often to a good depth. This renders them more friable, improves aeration and facilitates the rapid movement of soil water.

The more broken up and friable the soil is, the less is the direct runaway of water during rains. A common condition on Ceylon properties is that known as "crapping," in which we have an overlying stratum almost impervious to water. To break up this layer is one of the most difficult problems for Superintendents and one which gives much anxiety when proposals for cultivation and manuring are being considered. Such a condition would not have been produced had cover crops been grown from the commencement of planting, and if a cover can be successfully established the penetrative action of the roots brings about a marked improvement in this respect.

(*c*) *For the Conservation of Soil Water.*—When the soil is exposed to the tropical sun it gradually becomes baked and hardened. Rain water falling on this surface penetrates with difficulty and the greater part of it runs over the surface and is lost. Again, the evaporation from such soils is much more rapid than from friable soils owing to uninterrupted capillarity in the soil and there is considerable loss of water from this cause. As an adequate supply of soil water is necessary for the activities of the micro-organisms in the soil and for the growth of the rubber it is desirable to maintain this to the fullest extent. If a good soil texture is created and there is a sufficiency of

humus in the soil an adequate supply of soil water will be ensured, and this can best be brought about by the establishment of cover crops.

On the other hand it is sometimes urged that cover crops compete with the rubber for water owing to transpiration from their leaves. Experiments in Tea at Peradeniya Experiment Station have shown that for the first two years of growing a cover crop rather more water is lost by transpiration from the leaves of the cover than from bare soil, but the difference is not significant except during long droughts. Afterwards the accumulation of humus and the penetrative action of the roots of the covers leads to an opposite state of affairs and less moisture is lost than is the case from bare soil.

(*d*) *For the Preservation of Nitrogen.*—One of the principal elements required by rubber for satisfactory growth is nitrogen, and everyone is familiar with the rapid improvements which take place in backward areas of rubber after a course of nitrate manuring. Newly opened land is usually well supplied with nitrogen, but this steadily declines under cultivation, depending on the amount of erosive action which takes place. As soon as the land is exposed after clearing the jungle the soil nitrogen is rapidly changed to nitrate and for the time being conditions are very favourable to the growth of the young rubber which has been planted. There is not this rapid change from soil nitrogen to nitrate in land under cover crops, and it is probably this fact which has influenced the clean weeders to declare that the growth of the young rubber is better in clean weeded areas than in areas under a cover plant. This sudden access of fertility, however, cannot be maintained under the severe conditions of tropical sun and rains, exhaustion sets in, and growth slows down. The need for more nitrogen then becomes imperative and artificial manures are advised.

If, however, a suitable leguminous cover crop is established from the time of opening the supply of nitrogen can be maintained, and though the growth of the rubber may appear to be slower it will prove, in the long run, to be better sustained. Leguminous covers have the power, through the nodules on their roots, to utilise atmospheric nitrogen and to fix it in the plant, so that when this dies or is dug into the soil the whole of this nitrogen is returned to the soil. The constant decay of the root system of a cover crop and the accumulation of the fallen leaves increase the humus content of the soil and under this cover the micro-organisms can carry out their work at the maximum rate. This leads to a definite improvement in soil fertility instead of a state of exhaustion such as takes place in clean weeded areas.

### 2. Green Manuring.

It has been shown that cover crops serve to reduce erosion, to improve the texture, to increase the water content, and to conserve the nitrogen of soils. These services alone would be of great value in rubber cultivation, but there is no reason to rest contented with these benefits, great as they are, for by the proper utilisation of cover crops they can be made to serve other useful purposes.

If we allow cover plants to grow for too long a period without paying any attention to them a state of staleness may set in, causing the cover to lose vigour and sometimes to die off altogether. The well known practice of rotation of crops in agriculture is the means adopted to prevent a similar condition, and we cannot be sure of retaining a cover crop unless we take steps to use it. By digging the cover into the soil at regular intervals we can avoid this staling and keep the cover actively growing. In addition, we can, by so doing, add to the soil considerable quantities of organic matter which we have seen is essential for the maintenance and improvement of soil fertility. All the leguminous cover crops are valuable in this connection, and to those already referred to we may add those with an erect type of growth, namely, *Tephrosia candida* (Boga medelca), the species of *Indigofera* and of *Crotalaria*. It is necessary to emphasise that the manurial benefits of green cover plants are not fully secured until they are buried and incorporated in the soil and that the mere growing of a cover crop is insufficient to improve fertility.

It is not the actual amount of chemical matter added to the soil which increases fertility but the combination of factors already referred to. In this connection the question is often asked whether green manures can be used entirely to replace artificial manures. Unless the supply of green substance is very abundant the humus in the soil may, if used alone, become depleted at a greater rate than it can be replaced. By the addition of a proportion of artificial manure the call on the humus can be better regulated and the beneficial results be spread over a longer period of time. It is considered by those who have studied this question that a combination of artificial and green manures gives better results than a similar quantity of each if applied separately.

Having decided that cover crops should be utilised as green manures we have now to consider the time when such crops should be dug into the soil and the best methods of doing this. It is in this connection that opinions differ and it is the writer's opinion that no uniform system will meet all conditions.

In the case of all non-woody types of cover plants the best time for incorporating them into the soil is before the flowering period. During flowering there is a depletion of the nitrogen content in the leaves and shoots of cover plants, so that the full quantity of organic nitrogen would not be received by the soil. In the case of the shrubby or woody types there should be periodical lopping of the young green shoots and the incorporation of these into the soil. When these plants have become distinctly woody, they should be up-rooted and new plants put in to

replace them. It is not advisable to bury the woody parts as it has been found that if we bury the woody material along with the green matter there is a retardation of the rate of nitrification of the whole and in addition there is the risk of disease arising on the buried woody material spreading to the rubber. With regard to non-woody covers, experiments have shown that if the cover is cut into narrow strips it can be pushed into the soil and covered during what is known as envelope-forking. This method could also be adopted with the herbaceous loppings from *Tephrosia* (Boga), and *Crotalaria* or any other similar shrubby green manure crop.

Another system which has been practised with success has been to lay the loppings, woody or otherwise, in shallow trenches for ten days or a fortnight and then remove the wood from the trench. It was found that the whole of the leaf had separated from the shoots, and formed a layer at the bottom of the trench. This was covered with earth previously taken out of the trench and the woody material was laid in lines below the trenches, forming a very effective terrace. Such a system would, in the writer's opinion, prove suitable in all areas where Boga or *Crotalaria* has reached the woody stage and is due for removal.

The desirability of using artificial fertilisers along with green manures has been referred to and questions are often asked as to how this can best be done when covers are already well established. The artificial manure can be broadcasted over the cover just prior to envelope-forking or be mixed with the leaf-mould in the trenches at the time the woody material is being removed or alternatively it can be run along the grooves after envelope forking. The purpose of all manuring is to secure the incorporation of the manure in the soil and any method which will enable this to be done may be adopted. This appears to the writer to be a problem for practical men conversant with the conditions existing on their respective properties and no hard and fast rules can be laid down as to the best method to adopt. The conditions on rocky slopes are very different from those on flat land, and hard kabooky soils cannot be dealt with in the same way as soft loams. Each condition should be studied and the method made to fit the case.

### Conclusion.

In conclusion, it is necessary to refer to the problem of root diseases of rubber in association with cover crops. There can be little doubt that the growing of cover crops sometimes encourage the development of root diseases and one is frequently confronted with cases where the mycelium of fungi such as *Fomes lignosus* and *Poria hypobrunnea* have spread from one tree to another along the roots of cover crops. The cover crop may not itself be affected by the fungus but may serve merely to facilitate the spread from one point to another. On the other hand the writer has frequently observed cases of actual attack of cover crops of the woody type *Tephrosia* and *Crotalaria* by *Fomes lignosus* in close association with affected rubber trees.

While recognising the possibility of spread of root disease in this way the writer is of the opinion that if such occurrences are treated in the way advised for all attacks of root diseases no great extensions of diseased areas are likely to result. Up to the present time experience has shown that such areas form a very small proportion of the areas at present under cover crops and it would therefore, be a mistake to deprive oneself of the undoubted advantages to be secured from the growing of cover crops because of the possible danger of a small addition to the amount of root disease which may arise.—(*The Tropical Agriculturist*, Vol. LXX, No. 5.)

## SUGAR-CANE HYBRIDS.

It is well known that the sugar-cane in Java has suffered very badly from 'sereh' and mosaic diseases. G. Bremer (in *Archief voor de Suker-industrie in Nederlandsch Indie*, part III, 565, 1928) has published an account of crossing and back-crossing varieties of *Saccharum officinarum* and *S. spontaneum* which resulted in the production of hybrids with high sugar content and immune or very resistant to these diseases. The following cytological details are abstracted from an English summary received from the author. *S. officinarum* has 40 chromosomes (haploid) and *S. spontaneum* 56, while the F1 of the cross between them had 136. The author concludes that the additional 40 chromosomes originated by the longitudinal splitting of the maternal (*S. officinarum*) chromosomes during fertilisation. The F2 plants in general resembled those of the F1 generation. Back-crosses of *S. officinarum* and F1 plants had 148 chromosomes, indicating that the haploid number of the former had doubled again during fertilisation. It was by crossing these back-crosses again with *S. officinarum* that plants were obtained of high value for cultivation and resistant to both 'sereh' and mosaic. The somatic chromosomes of plants from this crossing varied in number from 106 to 120. A hybrid of *S. officinarum* and a variety of *S. spontaneum* from North Celebes again showed an increase of 40 chromosomes, presumably through the splitting of the *S. officinarum* chromosomes. There is some evidence that the size of the plants in *Saccharum* is dependent on the chromosome number. Some of the new sugar-canes, with about 57 as the haploid chromosome number, obtained in the above experiments were crossed again with *S. spontaneum*. From these crosses robust plants were obtained with about 170 chromosomes in the somatic cells. Though these hybrids are useless for cultivation, it is suggested that recrossing them with the best varieties of *S. officinarum* might result in some hybrids of high value with very high chromosome numbers.—(*Nature*, No. 3074, Vol. 122.)

## WITCH BROOM DISEASE.

*Witch Broom Disease of Cacao and its Control by F. Stell, and a note by Hon. A. B. Carr. Appendix. What is a fungus? by F. Stell. Reprinted from Bulletin, Department of Agriculture, Trinidad and Tobago, Vol. XXI. Part* 3, 1928.

THIS booklet has recently been issued by the Department of Agriculture, Trinidad and Tobago, for distribution to the cacao planting public of Trinidad. As explained by Stell in his introductory remarks the account gives a clear idea of Witch Broom Disease and its methods of control. It is a semi-popular one, and has as its object the amplification of information already published in leaflet form.

The account comprises the history of the disease since it first attracted attention in Surinam in 1895, its distribution within the island of Trinidad, where both infected districts are low-lying with a rainfall of between 100 to 120 inches per annum, and a full description of the symptoms of the disease and the fruit bodies of the fungus. Cultural studies and inoculation experiments carried out by the author are also described. The origin of the disease in Trinidad is treated under the following headings.

(*a*) That it is an introduction from the Mainland.

(*b*) That a species of "Wild" cacao in the Central Range Reserves may be responsible.

Under the heading of "Control Measures" both indirect and direct methods of combating the disease are dealt with and the reasons for each operation are given in simple and clear language. The indirect methods of control which are recommended are (*a*) *Shade*—A gradual reduction of shade trees in the infected areas, (*b*) *Pruning*—Annual pruning is recommended as being beneficial apart from Witch Broom Disease. The author, however, urges that this should, in infected areas, become a routine practice especially if done towards the end of the drier months when new growth appears. In regard to the disposal of the prunings, the author recommends as follows :—

"In view of the possibility of some of these prunings being already infected it would be good policy to make trenches between the rows of trees, bury the prunings and cover with earth. This system which has been practised with success at the Department's River Estate, for some years, is coming into increasing favour in cacao cultivations in the island. It should prove a good sanitary as well as cultural operation in the infested territory." (*c*) *Drainage*—The infected trees are on low-lying heavy clay and the rainfall is high. For these reasons an improved system of drainage is recommended, not that this would have a direct beneficial effect in reducing the incidence of the disease, but as found in Surinam good drainage strengthens the trees and makes them more resistant to the effects of the disease.

The direct means of control are (*a*) *The constant collection and destruction of diseased material.* To be effective it is considered that the infected material on the trees should be worked every two weeks. After the removal of diseased flower cushions it is recommended that the exposed surfaces should be tarred. All diseased pods should also be collected and all infected material buried at a depth of a foot and covered with earth. It is stated that if this is done the fungus will perish. (*b*) *Spraying*—It is also considered sound policy to spray the trees with Bordeaux Mixture in the dry weather after the operations under (*a*) have been carried out. The author concludes his lucid account with the encouraging and optimistic statement that under prevailing conditions in Trinidad the disease will be controlled, if all the cultural and specific recommendations are applied by all the planters whose cacao plantations are affected.

Stell's account of the disease should serve its useful purpose amongst all those interested in the welfare of the cacao industry in Trinidad since the information about the disease is as up-to-date as possible and many of the measures recommended against the disease are, within their limitations, sound. The present writer, however, finds it difficult to agree with Stell on a number of points and feels that there is ample room for further research work on lines which, up to the moment, have not been followed at any rate to their limit.

The points on which the writer disagrees with Stell are as follows :—

I. The system of burying prunings in trenches between trees has been practised with success at River Estate and it is considered that the same system would provide a good sanitary as well as cultural operation in the infected territory. The soil at River Estate is a light sandy loam which can be effectively drained without much difficulty. As explained by Stell the soil in the Witch Broom areas is low-lying, flat, and is a heavy clay. This difference in the soil texture makes all the difference in regard to the best method of disposing the prunings. If they are buried in trenches between the trees on the heavy low-lying lands there will be distinct danger of an outbreak of disease far more destructive than Witch Broom Disease, *viz.*: Rosellinia Root Rot. When the prunings decompose in the soil they are reduced in bulk and the soil over-lying them sinks in consequence, thus forming a water-logged strip throughout the plantation. The acidity of the soil will probably be increased in this region and the water-logged, acid, decomposing mass of vegetable matter will render conditions extremely favourable not only to Rosellinia but also to Die-back. Oil is cheap in Trinidad and the diseased prunings could be burned without much difficulty if the work is properly organised. The normal prunings should be used as a surface mulch.

II. It is stated that investigators found in Surinam that good and bad drainage had no visible influence on the susceptibility of the trees

to Witch Broom because both strong and weak trees suffer from it. Good drainage, however, strengthens the trees and in this way makes them more resistant to the effects of the disease. The latter conclusion is probably very sound but the former statement leaves too much unanswered before it can be accepted without comment. The observations made on the incidence of the disease on strong and weak trees is probably correct but it is in no way proof that drainage does not affect the incidence of the disease. The reverse conclusion would probably be more correct and in any case the following point of view might serve to suggest further investigation of this most important point. It is very probable that a humid atmosphere (*vide* Stell's remarks in regard to Shade and Black pod) is conducive to a higher percentage of successful infections by the spores of the Witch Broom fungus. This being so it is evident that an improved system of drainage will reduce the humidity of the atmosphere above the ground and within the crop. *Ipso facto* it will reduce the incidence of the disease.

III. After the removal of the diseased flower cushions it is recommended to cover the exposed tissues with tar. Research work on a spore-producing fungus in orchards in England has shown that tar is not effective as a wound dressing. In addition to the fact that it is not efficient as a fungicide there is also the further objection that it takes longer effectively to cover a wound with tar than with the more fluid, less sticky, and very efficient fungicides such as Brunolinum, Carbolineum, Solignum, &c., which are used so extensively in the rubber growing countries of the eastern tropics. Furthermore, tar keeps the underlying tissues moist and in consequence various forms of rots are liable to set in.

## The need for further research work on Witch Broom Disease.

At the moment there are two schools of thought in regard to the control measures necessary to combat the disease effectively. Some there are who consider the measures recommended to be adequate and effective whilst others advocate the total destruction of the infected trees to safeguard cacao plantations in other parts of the island. Those favouring total destruction of infected trees base their arguments on the unquestioned failure of the less drastic recommendations in Surinam. On large areas in Surinam, in spite of the fact that attention has been paid to shade reduction, spraying, pruning, and drainage, a change of crop from cacao to coffee has been found to be the best way out of the difficulty. On the other hand, and as pointed out by Stell, conditions in Surinam are so markedly different from those in Trinidad that the measures which have failed in the former might prove effective in the latter. So far as present knowledge of the disease goes it is impossible to state with any degree of certainty which of the two schools of thought is the correct one. There is the further possibility that, if further information was available on certain important points, neither school would be found to have decided on the most economic course of action. Total destruction of trees in the affected regions does not necessarily mean the total eradication of the disease since it may be found to appear later in a plantation where conditions are suitable. This procedure if carried out to its limit would cost a considerable amount of money. If the less drastic recommendations already referred to are carried out there is the uncertainty in regard to the rate and the extent to which the disease may spread throughout the cacao plantations in other parts of the island. In this connection it is to be borne in mind that there is the possible risk concerning the major crop in Trinidad. The extent of the danger to the cacao crop in other parts of the island is a matter of doubt at the present time and hand in hand with this go the differences of opinion as to what is adequate and effective treatment.

The Department of Agriculture has made all effort to combat the disease and figures are available which show that there has been an appreciable reduction in the number of unit infections. On the other hand it must be remembered that the rainfall in the present wet season has been below normal so that for the period of the year the figures may be misleading. A normal wet season may show a further increase later. Reduction of loss due to disease can undoubtedly be obtained by the present methods of control, but it is generally felt that complete eradication of the disease is really what is required in Trinidad. This need not necessarily mean the destruction of all trees in the affected areas. It is possible that if information on certain essential points were obtained, as the result of systematic investigation, such a means would be forthcoming. At the monemt no confident decision can be made since there are several questions of importance which cannot be answered without further research work. For instance, it has been stated in various publications that the spores of the fungus *Marasmius perniciosus* lose their viability in a short time in a dry atmosphere. In dealing with a matter of so much economic importance the term "dry atmosphere" is much too vague. Furthermore, the question of importance is how long the spores of the fungus can retain their viability between the bud scales. The humidity of the atmosphere here may not be low enough to cause the death of the spores and may at some periods in the year not be high enough to bring about germination. There are periods of the year during which there are definite flushes of growth in cacao. This is not without its significance in regard to this disease particularly following numerous pruning operations preceding them. This leads to another point of the utmost importance, namely, as to whether a spore lodged between the bud scales does on germination, actually infect the tissues of a dormant bud and thus stimulates it into growth, or whether the germinating spores

can only infect young tissues undergoing normal development. In any case it opens out a field of investigation as yet untouched. A thorough study of the physiology of the fungus coupled with definite trials of fungicides with a better wetting power than Bordeaux Mixture and with properties which the latter does not possess might lead to results of the first magnitude, not only in regard to the most effective and economic measures against the disease in infected areas, but also in regard to the danger or no danger to the crop in other parts of Trinidad such as the Northern Range which is also wet at certain times. Such a study would define more clearly the extent of shade reduction necessary against the disease and also whether the cacao grown in infected areas would tolerate this essential reduction. The work could go hand in hand with the study of Black pod and Canker Disease and very far-reaching results might be obtained. Shade is a much debated point in cacao cultivation in Trinidad but if considered in terms of transpiration of the cacao plant it will be seen that the main factor governing shade in cacao is quality and type of soil.

Most fungus spores and possibly those of the Witch Broom organism can be carried on the wind for long distances. It will be noticed that all the infected areas occur on the eastern side of the island and that large areas of cacao, including the Northern Range, lie directly to the leeward of the prevailing wind.

H. R. Briton-Jones.

## VIRUS DISEASE.

As a result of a recommendation made at the Imperial Agricultural Research Conference a Committee has been appointed by the Government to consider "the more extended study of the fundamental nature of Virus Diseases in plants." The Committee will consist of :—

- Professor V. H. Blackman, Director, Plant Physiology Research Institute, Imperial College of Science and Technology;
- Dr. W. B. Brierley, Head of the Mycological Department, Rothamsted Experimental Station;
- Dr. E. J. Butler, Director, Imperial Bureau of Mycology;
- Mr. J. C. F. Fryer, Director, Plant Pathological Laboratory of the Ministry of Agriculture;
- Dr. G. A. K. Marshall, Director, Imperial Bureau of Entomology;
- Dr. G. H. Pethybridge, Mycologist to the Ministry of Agriculture (*Chairman*);

with representatives yet to be appointed of the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland, and Mr. G. E. Fussell of the Ministry of Agriculture as Secretary.

## PALM OIL INDUSTRY.

### Sumatra, Malaya and Nigeria.

An account is published in the *Sixth Annual Bulletin*, Agric. Dept., Nigeria, 1927, of Mr. H. B. Waters' 1926 visit, on behalf of the Nigerian Government, to oil palm plantations in Sumatra and Malaya.

The special features of the industry in Sumatra are detailed as being the excellence of the "Deli" type of oil palm; the rapid improvement in cultivation methods; the widespread use of green dressings; the progress in machinery development; the efficiency of the latest factories; the high quality and the bulk transport of the oil. The Sumatran oil palm industry appears to be in a very sound position, both agriculturally and commercially, its greatest safeguard being that the main product is of a very high grade, the modern factories turning out an oil with a maximum free acidity of less than 3 per cent. The real danger to the Nigerian industry is not the disappearance of palm oil cultivation which is too firmly established but the price of low grade oil which may be so reduced that it will not pay to produce it for export.

Although the suggestion, made by the Director of Agriculture in 1922, that the provision of central factories in Nigeria would alter the whole situation, it is pointed out that the Government would have to be helped by private capital before undertaking such a scheme. It is also stressed that factories thus established, should not only be supplied with fruit from modern plantations but also from small holdings so as to encourage natives to adopt the improved methods of cultivation. Yields per acre of fruit would tend to increase and the better grade of oil produced by the factories would enable Nigeria to compete with Sumatra.

Since the publication of this Bulletin proposals have been made by the Nigerian Government (*West Africa*, Vol. XII, No. 593) to subsidise the Colony's oil palm industry. It is suggested that financial aid is to be offered to a limited number of persons or firms for setting up factories equipped with machinery capable of extracting palm oil and palm kernels at the rate of 20 tons of fruit in ten hours. The subsidy has been fixed on a production basis, each mill being credited with a "rated capacity" of 280 times the oil produced in a ten-hour day. Owners, as before, will be allowed everywhere to treat their own fruit by machinery while freedom of sale is also to be guaranteed to all producers. The only restriction imposed is that factories will not be allowed to buy fruit within a radius of ten miles of each other. The scheme will be under the general supervision of the Director of Agriculture, and the Government will not enter into an agreement granting financial assistance to an applicant unless his proposals with regard to a factory have been approved by that official.

G. G.

## SUGAR NOTES.

**Compiled by the College Department of Sugar Technology.**

*Suggested Changes in Reporting Factory Results.*

The recommendations of a special committee of the Association of Hawaiian Sugar Technologists, reported by S. S. Peck, may be summarised as follows: while the figure expressing the gross weight of cane entering the mill may be (in Hawaii) as correct as it is possible to get such a figure it is submitted that it is of little comparative value. A milling plant is grinding fibre not cane, and the capacity of a set of rolls varies as the fibre content of the cane goes up or down. It would therefore seem more reasonable to report tons of fibre per hour and the fibre tonnage ratio, rather than the present cane figures. After considerable thought, the Committee cannot recommend the change to net cane, since as will be shown later, there is no evident advantage from the standpoint of insuring better comparison of work. But they do strongly recommend that for the purpose of making their reports comparable in so far as possible, that such factories as are now reporting net cane weights be invited to change to the system of gross cane weights.

*Juice Samples.*—The official methods prescribe that the first expressed juice sample be taken from the first set of rollers, and that the last expressed juice should be sampled from the top and the bagasse roller of the last mill and 75 per cent. of the factories follow this instruction. Five factories take the first juice from five rollers, and in four factories cush-cush is returned before the mill from which the sample is taken. These instructions are so simple to follow that such exceptions should not exist. Thirteen of the factories (not including the Petree houses) make no correction for suspended solids in the mixed juice. Ten (again not including the Petree houses) do not include the press-juice in the clarified juice sample; and five include remelt in the reported syrup. It is unfortunate that these exceptions exist. If we further consider that two-thirds of the factories weigh the molasses and that the balance and recovery account is based on sucrose in the case of only nine factories, it becomes at once apparent that our comparative factory data are comparable in name only. *Java Ratio.*—In the first report of the Committee of Methods of the H.C.A. the polarization of the cane was determined by a factor now known as the Java Ratio. A table was given in which this factor varied from a low of 81.95, where the fibre of the cane was 13.5 and the juice extraction 60, to a height of 87.30, where the fibre per cent. cane was 9.5 and the extraction 75. We have no low fibres such as 9.5, and the average juice extraction is probably under 60, but according to the last report of the station on recovery, this ratio varied from 76.7 to 86.2. This figure is of no significance from the standpoint of comparisons, and might be well left out of reports. *Quality Ratio.*—This figure as it now stands is a simplification into one figure of the two figures, purity and polarization, of the first expressed juice. It is a useful figure in making field tests of various cane samples, and from this is derived the figure for tons of cane per acre from such tests, as appear in the frequent articles on cane plot tests. From this connexion, it has been easy to assume that quality ratio signifies tons cane per ton sugar, whereas it means this only under certain assumed conditions, with which you are well acquainted. But amongst these is an assumed Java Ratio of 80 which has already been shown to vary widely in different factories, and to be not at all comparable. Likewise, a quality ratio based on this varying figure is not comparable. A new quality ratio is proposed, based on the same difference in purity between first juice and syrup, namely 1; and the same quality of sugar, namely, 97 polarization and 98 purity; and the same extraction, 98. It differs from the present basis in that it is worked out from the polarization of the cane and not from that of the first juice, and referred to a molasses of $33\frac{1}{3}$ purity instead of 37. *Sugar Ratio.*—A new term is presented in that of sugar ratio. For comparison purposes, all factories must refer their juice as quality ratio to a sugar of the same composition. For the use of each factory, particularly where sugars of high polarization are being manufactured, it will be more desirable to refer to the actual sugar as bagged. This is not to be taken as a comparable figure. It gives tons of cane required to make a ton of the kind of sugar manufactured, provided the extraction is 98, the syrup purity is one less than that of the first expressed juice, the molasses purity is $33\frac{1}{3}$, and there have been no other losses. The figure can be used valuably as a basis for field distribution, and is the basis for the next suggested figure. *Recovery Ratio.*—Knowing the sugar ratio and the actual tons of canes required to make a ton of sugar, there is obtained a relationship which is suggested as a "recovery ratio." As the mill performance approaches the conditions assumed, the recovery ratio will near 100. It is presented as a figure to be used in measuring the relative efficiency of different plants, and it is not strictly correct, but approximately so. *Mill Control.*—Some years ago, J. P. Foster, of Paia, started to prepare charts from the brixes of the juices of his 21-roller tandem, in which the curve of the descending gravities of the expressed juices was shown. He found a distinct correlation between extraction efficiency and the form of his curve. During the past year, Walter E. Smith has used this system, while William Worth has prepared regular charts for his milling work for this Committee, which showed that good milling work can be relied upon to give charts with a regular drop in density from the first to the last juices. The system is recommended as a valuable help to the engineer. *Milling Figures.*—As mentioned it is proposed that tonnage ratio be left out of the comparative reports, to be replaced

by fibre tonnage ratio. Neither of these figures, however, gives a suggestion as to possible causes of high bagasse moisture, and a further figure of tons fibre per linear foot of roll per hour is suggested. The calculation is much shorter than the name implies, and it does give a closer correlation between moisture per cent. bagasse than does the present tonnage ratio or would the fibre tonnage ratio. It is further suggested that extraction ratio be reported as the reciprocal of the present figure, or, in other words, be obtained by dividing the fibre per cent. cane by (100—extraction). This gives a sensible figure, and the figure varies directly and not inversely with the quality of the work. Thus a factory with 98.77 extraction reports in extraction ratio of 0.43. The difference does not seem large as between 0.10 and 0.43 to the uninitiated, but if stated as 10.00 and 2.04, respectively, the difference would be notable, and in the right direction. As a matter of fact, extraction ratio is a misnomer; it should be titled non-extraction ratio.—(*International Sugar Journal*, No. 359. Vol. XXX, p. 611.)

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*Calcium-free Juices.*

L. van der Heide. *Chem. Weekblad*, 25, 274-7 (1928) discusses the relation between the pH and the Ca content of solutions containing (*a*) lime, (*b*) lime and soda, (*c*) lime and Ca salt and (*d*) lime Ca salt and soda, and through which $CO_2$ is passed. It has been found that: the minimum Ca content in *c* is not always reduced to the minimum found in *a* on the addition of the equivalent quantity of soda; the pH near which the minimum Ca content is found is dependent on the nature and quantity of the salt present, and, in general, is not equal to the pH in *a*. A high value for the minimum Ca content does not require a low pH; the further the pH in *c* is from the pH in *a* the less is the equivalent quantity of soda sufficient to remove the Ca completely from the solution; the pH in *a* is little influenced by the addition of the soda required for the removal of the Ca. The possibility is suggested of treating Java cane juices with soda in order to obtain Ca-free juices.—(*Chemical Abstracts*, 1928.)

## MANGROVES.

The greatest commercial value of mangroves lies in the tannin contained in the bark and also in the timber and leaves. The dry bark of quite mature trees has yielded 25 to 45 per cent. of its weight in tannin from which a tanning extract is derived, the commercial importance of which is increasing rapidly in the United States to which it is imported chiefly from East Africa and the West Indies. The timber of *Rhizophora mangle* which is of a dark rose colour, very resistant and almost imperishable in water, is chiefly used as fuel and to make charcoal and is found throughout the West Indies and in the tropical regions of South America.—(*International Review of Agriculture*, Year XIX, No. 4.)

## UGANDA COTTON INDUSTRY.

This Protectorate has hitherto been the chief cotton-producing area in the Empire. In 1920-21 81,365 bales were exported, and in 1924-25 the number had risen to 196,038. Since then the exports of cotton have fallen to about 130,000 bales. This fall has been due partly to weather conditions, and partly to the fact that the native growers have been discouraged temporarily by lower prices. In 1925 cotton-growing in Uganda had reached a stage when future increase depended not so much on expansion of the area under cotton, as on a larger yield per acre. Such a result might be achieved either by improved seed or by better cultural methods, or by a combination of both measures. The Cotton Botanist is making good progress as regards plant selection and breeding; but this is only the first of several stages by which better seed reaches the farmer, and both seed multiplication and distribution present considerable difficulties in Uganda. At present, the seed to be multiplied is grown in segregated areas, and this is an arrangement which is never easy to control in such a way that the purity of the resultant seed can be guaranteed. Seed distribution in the Protectorate is greatly complicated by the excessive number of ginneries that have been allowed. Apart from the other disadvantages of a multiplication of small ginneries, such as over-capitalization and high ginning charges, their number makes it extremely difficult to control the seed supply rigorously, and such control is particularly desirable where the farmers are natives who do not fully appreciate the value of good seed or the importance of a high-grade crop.

Owing to the efforts of the Agricultural Officers of Uganda, natives have made a much greater use of ploughs than heretofore. In 1923 there were 287 bullock ploughs in the country and by the end of 1926 the number had increased to 3,000.

A fall in the price of the raw material is not likely permanently to discourage the people from growing cotton. At present their only other cash crop is coffee, and that cannot, generally speaking, be grown in the same area as cotton. They have become slightly and not unnaturally demoralized by an easy success in a country singularly blessed by nature and by the high prices they were able to obtain for a few years following the War, but, having felt the advantages of comparative riches, they are not likely to revert to comparative poverty through sheer idleness. To ensure the continued success of the cotton-growing industry on sound foundations, what is most needed is an efficient machinery for the multiplication and distribution of seed, and the stability and better organization of the ginning industry.—(Extract from *The Empire Cotton Growing Corporation Review of the Situation in the Principal Cotton growing territories of the Empire*, 1928.)

## TROPICAL WORLD NOTES.

### *East Africa.*

The weekly edition of the *East African Standard* (No. 2086) contains an article where the Empire Marketing Board's work on behalf of the East African territories has been reviewed. The Board has contributed grants amounting to £37,000 to East Africa and these have been allocated as follows:

(i) £6,000 per annum for three years towards the cost of maintaining the research station recently re-established at Amani.

(ii) £10,000 towards the Rowett Institute pasture deficiency investigation which is being carried out in Kenya.

(iii) £3,000 per annum for two years for dietetic research in connection with Kenya native tribes.

(iv) £3,000 to assist the Kenya Government to meet half the cost of the freight when importing pedigree livestock.

Some of the other activities of the Board include: trial shipments of pine apples from Zanzibar, the introduction of almond cultivation into Nyasaland, and a widespread advertisement campaign of East African produce. They have also obtained the co-operation of one of the world's foremost authorities in the task of preparing a research scheme into the causes of East Coast Fever. The Board's future policy includes an investigation of the development of new forms of mechanical transport suitable for Colonial areas where railways would be uneconomic, and the carrying out of experiments in trial exports of tropical fruits from the East African Dependencies.

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### *Porto Rico.*

The hurricane which swept the Island of Porto Rico caused extensive damage to all the crops in that Island. The Bureau of Agricultural Economics of the United States Department of Agriculture received cable advices from Assistant Director I. L. Torres at San Juan, Porto Rico in which a statement is made that the sugar-cane fields which were especially promising in the month of August, suffered heavily from damages by the hurricane and that the crop was probably reduced by 150,000 to 200,000 short tons of sugar. Last year's sugar crop was the largest on record, being officially placed at 749,000 short tons.

All tobacco seedbeds and barns were totally destroyed. There is still time to prepare seedbeds and plant the crop, but destruction of the barns will be a serious handicap to the curing of any tobacco produced during the 1928-1929 season.

The coffee crop was practically ruined and minor crops, including rice and bananas, are completely destroyed.

Reports coming from various sugar districts indicate that considerable damage has been done to sugar mill buildings although most of the heavy machinery appears not to have suffered so much, except at Vannine, where it was heavily damaged by a falling chimney.

All warehouses at Humacao are reported destroyed and their contents lost, including a thousand tons of German fertilizer and considerable sugar belonging to Centrals Juncos and Paste Viejjo. The warehouses are reported insured, excepting one, just built by Central Ejemplo at a cost of $60,000.—(*The Planter and Sugar Manufacturer*, Vol. LXXXI, No. 13.)

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### *The Leeward and Windward Islands.*

The following items have been extracted from information supplied by the Agricultural Departments of the several islands concerned:

*Montserrat.*

A good cotton crop has been harvested with yields above the average in most districts. Work in the ginneries began in August and the returns showed a marked improvement. After the hurricane of 12th September all ginneries were temporarily repaired and by the end of October, 416,000 lb. of cotton were shipped. A very satisfactory crop of limes had been anticipated but the hurricane destroyed practically all the bearing trees. The Peasants' Information Bureau's work has been started, nurseries being selected and laid out and the planting of seed commenced; after the hurricane large numbers of seedling plants and sweet potato cuttings were also distributed.

*Dominica.*

Dominica also suffered severely from the storm, damage being done to lime and other cultivation throughout the island. Plots in the Lime Experiment Station suffered so severely that they cannot at the present time be used for experimental purposes.

*St. Vincent.*

The maize crop promises to be better than that of the previous year. Little damage has been done by the arrowroot worm and the cotton crop also is likely to yield well.

*St. Lucia.*

The Reunion Station is being abandoned and economic plants are being transferred to Union which is being re-established as an Experiment Station after a lapse of 16 years. The cane growing area in the island is being extended. A good cocoa crop is expected and the coconut groves were generally looking well. The lime crop is likely to be short. Exhibits have been packed and shipped for the Canadian National Exhibition.

*Nevis.*

The island suffered heavily from the hurricane, damage being done to sugar estate works, small windmill works and coconut plantations, about 6,000 plantation trees being destroyed; livestock losses were also heavy. Cotton planting has begun, the area for the coming crop being estimated at 1,200 acres.

## CHEMICAL NOTES.

**Compiled by the College Department of Chemistry and Soil Science.**

*Solid Alcohol.*

The difficulties encountered in transporting, handling and storing ordinary liquid alcohol, have prompted investigators to search for a method of obtaining alcohol in a solid form. The principle of the method is to include alcohol in a jelly in much the same way as water can be included in a gelatin jelly. The latter contains a high percentage of water. The similarity in the properties of alcohol and those of water should enable alcohol to be included in a similar way. Soap with shellac, stearin, sodium silicate, collodion, or cellulose acetate added have been used to form a jelly with alcohol. The alcohol so held could only be used for purposes of combustion. The use of agar-agar and gelatin is not practicable. According to a German patent, stable gels containing a high percentage of alcohol have been obtained by the addition of certain solid materials, or their concentrated aqueous solutions, to the boiling alcohol. The product, which solidifies on cooling, is completely soluble in water and is without taste or smell. To harden the solid such substances as the alkali salts of the sulphuric acid derivatives of diacetone glucose, diacetone fructose, acetone glycerin are added. The process is still expensive, but once this has been overcome it is expected that it will have an important influence on the liquor, pharmaceutical and cosmetic industries.—(*Ind. Eng. Chem. New Ed.* 6, 20, 3.)

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*Cellulose from Waste Vegetable Matter.*

Among the many methods for the production of pure cellulose from waste vegetable products, few can be profitably operated on the growing site of the raw material. Transport charges are correspondingly high. A recent British patent provides a method which could be used in the tropical countries which are becoming the main source of raw material. The bamboo, bagasse, straw, jute, grass, wood or whatever material is used, is first crushed and disintegrated. It is then soaked in the unfermented sap extracted from freshly cut, mature banana leaves. The soaking is then continued for from four to nine days at a temperature of 32°. At the end of that period the liquor is run off and is valuable as a fertiliser since it contains many nitrogenous compounds. The cellulose remaining in the tank is washed first with cold diluted hydrochloric or sulphuric acid and then with water. Finally it is bleached. The cellulose thus produced may be transported in a more compact and economical form than the original waste vegetable material.

*Iodine as a Fertilizer.*

Iodine in fractional quantities is one of the elements essential for vigorous plant growth. Normally, there is a sufficient supply in the soil. Even if the soil is deficient, impure artificial fertilizers such as guano or Chilean nitrate of soda have an iodine content large enough to satisfy the requirements of the plants. Synthetic nitrogenous fertilizers of course contain no iodine; and it is suggested, particularly by the Chilean nitrate producers, that the removal of the supply of iodine to the soil by the continued use of synthetic fertilizers will eventually affect plant growth. Owing to the high cost of iodine and its compounds, it is not economical to apply separate dressings of those substances, and supplies will always depend on the presence of impurities. It is claimed that superphosphate contains sufficient iodine to satisfy the needs of plants (*Superphosphate*, Vol. I, 92). It is probable that most fertilizers not synthesised from pure substances contain similar traces of the element.

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*The Utilisation of Cotton Burs.*

Cotton burs, obtained during the shedding method of harvesting, hold the same position in the cotton growing industry that excess bagasse held in the sugar industry before the latter was utilised for the manufacture of Soltex boards. The burs are unwanted waste products of which the only means of disposal is by burning. One county in Texas produced over 70,000 tons of burs from the 1926 crop.

Analyses of the burs for organic and inorganic constituents have been made with a view to finding some process by which they can be utilised. As they contain only 2 per cent. of fat and 7 per cent. of protein, and 45 per cent. of crude fibre they are unsuitable for feeding stuff. It is even doubtful whether a hydrolytic treatment with sulphuric acid would produce a digestible food. The low content of pentoses removes the possibility of their use as a source of furfural. Their high cellulose content might make them a profitable source of pure cellulose. The ash contains a fairly high percentage of potassium, and some phosphate and calcium. The ash from the burnt burs is therefore used with advantage as a fertiliser. Application of the untreated burs is inadvisable owing to the high cellulose content, but it is suggested that they may be decomposed to form a valuable organic manure. Unless this final procedure is adopted a profitable method for the disposal of the bur seems as far away as ever.

An examination of the cotton-seed hull bran, obtained during the manufacture of cotton seed oil, however, gave more promising results. It showed that the bran contains a relatively high percentage of pentoses and it will consequently give a good yield of furfural. The bran may therefore find a commercial outlet as a source of furfural.—(*Journal of Amer. Soc. Agron.* 20, 1095, 1102.)

## REVIEWS.

Indian Agriculture by Albert Howard, C.I.E., M.A. and Gabrielle L. C. Howard, M.A. (Vol. VIII in "India of To-day" series), *Oxford University Press.*

This little volume of less than a hundred pages by Mr. and Mrs. Howard, of the Institute of Plant Industry, Indore, is called "Indian Agriculture" on the cover, but is more accurately described on the title page as "The development of Indian Agriculture." The book is made up partly of summaries, excellent but naturally very compressed, of the present state of the agricultural population of India and the methods in which they pursue their calling; and of the foundation of the present Agricultural Service of India, and the progress that has been made in Agricultural Research since the Department took on its present organisation under the direction of the late Lord Curzon in 1904. The remainder of the book contains the authors' views as to the most important problems which await solution at the present day and the lines on which they should be attacked, and in reading these, it is very necessary to bear in mind the General Editor's note, printed prominently at the beginning of the book, that "the opinions expressed are those of the author, and no other person shares responsibility for them."

To take the book more in detail, after a preliminary discussion emphasising the overwhelming proportion of the population that depends directly or indirectly on agriculture, more than 90 per cent. in fact, we are given a chapter on the factors underlying production, which is a jumbled account, often very elementary, of such subjects as the theory of plant nutrition, the importance of the monsoon, the damage done through soil erosion by running water, the need of drainage and the value of oxygen to the plant, much of which might have been omitted. Then follows an excellent chapter describing concisely the organisation and development of the Indian Agricultural service and other bodies concerned with Agricultural Research in India up to the present day.

The next chapter dealing with the main practical results which have been obtained from this research, is unequal in merit. The section dealing with the improvement of crops, in which Mr. and Mrs. Howard have themselves taken a leading part is excellent, and might well have been expanded; the portion dealing with soils, cultivation and manures is less satisfactory and deals less with facts than with doubtful theories.

The last three chapters deal with the difficulty which all agricultural workers in India have felt, that of really awakening enthusiasm among the villagers over the suggestions for improvement that can be made. The application of science to this ancient industry has shown again and again that considerable progress can be made, but yet only the merest beginnings in what the authors term 'rural uplift' have been accomplished. Many of the causes that contribute to this state of things are pointed out: general illiteracy, the almost universal indebtedness, the absence of any desire for a better life, all contribute to reduce the rate of progress. The authors' criticism of present methods, is that rural development has not been studied as a whole, that there is in fact too much tendency in India to attack a problem by means of separate sciences, and that this is not only ineffective but wasteful; their remedy, the creation of a single agency, for which they suggest the name of the Development Board of Rural Reconstruction. Unfortunately the production of the present book is rather a warning of the pitfalls that lie in wait for authors when they wander away from their 'separate' sciences, and try to cover too wide a field.

R. C. W.

* * *

The Agricultural Development of Arid and Semi-Arid Regions, with Special reference to South Africa. H. D. Leppan. (*Central News Agency, Ltd.*, price 25s. pp. 280.)

The Professor of Agronomy in the Transvaal University has produced a most interesting and stimulating work, which deals with the special difficulties which farming in South Africa has to face, on account of the general insufficiency, and still more, the uncertainty of the rainfall, and suggests various means whereby these difficulties may be minimised. In pursuance of this object, the author has studied the systems of agriculture at present practised in the Bombay Presidency, on the East side of Peninsular India, and in the drier areas of Australia and the United States, and has been able to make some very pertinent suggestions.

The earlier chapters are devoted to a careful consideration of conditions as they exist at present in South Africa, and the lines of future development. Of the various handicaps, political, racial, and physical, under which the country suffers, the most potent are the violent fluctuations imposed by its climate. The consequent instability which characterises agricultural effort in South Africa, tends to keep down the standards of farming in every direction; it cripples credit, discourages labour, retards close settlement, hinders transport, and generally keeps back development.

The author's somewhat pessimistic outlook does not however, prevent him from seeking for remedies, and his description of the conditions in other arid and semi-arid countries, and the means they are adopting to improve the situation, makes extremely interesting reading. From the Bombay peasant, he learns the possibilities of a much wider choice of crop than is generally practised in South Africa, and is impressed by

the way the *ryot* modifies his system of cropping in accordance with the exigencies of the season, and, if the season be delayed, adopts an earlier maturing variety, which will probably be more thinly sown, or even substitutes another crop altogether.

In Australia, he admires the land settlement policy, which has been very successful in placing settlers on the land, and which has served as a model for similar legislation in India, Egypt and South Africa. The work of the United States Dry Land Agricultural Office is reviewed, and the valuable work of the Plant Introduction Office indicates the urgent need of a similar institution for his own country.

There is much detailed discussion of the many points involved; the position of the live stock industry and its combination with arable farming, the proper use of irrigation facilities, fruit growing and its possibilities, forestry, the dangers of erosion, which is already such a serious menace in many parts of Africa, but it is impossible even to mention them all here.

A final chapter concludes this able presentation of the subject, with a brief statement of the case; the conditions under which arid and semi-arid regions exist, and the general dominance of the animal industry in such areas. The author makes definite recommendations for an active policy in dealing with the situation.

Two maps are included, but it is unfortunate that they are on so small a scale and so poorly printed as to be of little use. Typographical errors are common throughout, and the price is excessive for a book of this size without illustrations.

R. C. W.

* * *

Goat Grazing and Forestry in Cyprus. A. H. Unwin. (*Crosby Lockwood & Son*), pp. 163.

The goat has ever been anathema to the Forest Officer, and the author of this book has marshalled chapter and verse to show the reason for this antipathy. Quotations from authorities in all parts of the world, Europe, Asia, Africa, and America, are given "to place before the public the view . . . that grazing, unless properly controlled damns all prospects of Forestry," though one is surprised that the experience of Hawaii, which offers a very close analogy to Cyprus, is not mentioned. The author is perfectly correct in his condemnation of the goat, and it is difficult, after reading his book, to understand why the administration still permits goats in any of the forest areas; one may perhaps presume there is something to be said on the other side. No information is given as to the reason for which the goats are kept, whether for meat, for milk (there are allusions to goat cheese), for their skins, or for their manure—it is a common practice for instance in Southern India to pen goats on the land by night to increase its crop yielding capacity. It is clear, however, that the question in Cyprus has become acute, and that a speedy choice must be made between the goat and the forest. The author indicates in a chapter headed: "Modern methods of breeding goats" how goats can be stalled and hand fed, where the animals are of sufficiently high class to make this worth while.

R. C. W.

* * *

Flora of Trinidad and Tobago, Vol. I, Part I, *Ranales*. By R. O. Williams. Price 1s. and Vol. II, Part I, *Rubiales*, by R. O. Williams and E. E. Cheesman. Price 2s., Department of Agriculture Publication, Trinidad and Tobago, 1928.

In an introduction, Mr. Freeman, the Director of Agriculture, explains the genesis of this work, the history of the departmental Herbarium, and the part taken by the earlier botanists in contributing to the present knowledge of this Flora. Vol. I, Part I refers to the *Ranales*, Vol. II, Part I to the *Rubiales*. Both are extremely lucid in detail and the arrangement is such as to make the diagnoses as direct as possible. As a result this should prove a valuable systematic work. Studies of this kind require much careful and painstaking labour. The reward is that they occupy a fundamental position in the accumulation of general botanical knowledge and are necessary forerunners to all other researches, academic and economic alike.

In the introduction acknowledgment is made to the help received from the Royal Botanic Gardens, Kew, and we extend to Mr. R. O. Williams and to Professor Cheesman our best wishes that this work may be continued so as to take its place with the classical floras associated with that institution.

C. W. W.

* * *

The Colloid Chemistry of the Rubber Industry. E. A. Hauser, *Oxford University Press*, 1928. Price 4s. 6d.

This book is a record of the first series of six Gow Lectures delivered at University College London, during November, 1927. Dr. Hauser is Professor of Colloid Chemistry at the Massachusetts Institute of Technology, and is well-known for his researches on the chemistry of rubber latex and the X-ray structure of rubber. The first lecture deals with the history of plantation rubber-growing, and of the vulcanization process in rubber manufacture. It also deals with the chemistry of latex. The second lecture discusses the factory processes carried out on the rubber plantation; the third presents the results of X-ray examination of rubber. Manufacturing processes, involved in the making of rubber

## SANT ANTONIO EXPERIMENTAL STATION.

*A crop of beans.*

*Part of irrigation canal.*

## ACADEMIC STAFF AND STUDENTS, 1928-29.

*Photograph by* *Tucker Picture Co.*

*Sitting on Ground* :—J. de la Bastide, G. B. Gregory, J. Goellnicht, J. A. Wirshing, D. S. Cozier, D. L. Ferguson, H. L. Manning, G. Briggs, R. D. M. Barnard, G. L. MacDougall, B. W. G. Austin.

*1st Row* :—C. T. Watts, A. G. Howell, E. A. Seagar, E. E. Cheesman, H. R. Briton-Jones, H. A. Ballou, G. Evans, F. Hardy, R. C. Wood, C. Y. Shephard, W. Scott, F. W. Urich.

*2nd Row* :—J. H. Aikman, L. A. Corbin, R. H. Hurst, G. Wright, A. K. Briant, H. H. Croucher, R. E. Hunter, A. L. Baker, G. G. Gianetti, T. R. Hayes, J. M. Wingate, L. S. Birkett.

*3rd Row* :—R. Leach, J. Wright, A. S. Thomas, J. F. Williams, A. F. W. Sheffield, J. M. Ward, R. S. Hanomansingh, C. G. Akhurst, F. R. Sanders, R. D. Linton, B. J. Hartley, W. B. Hutchinson, R. W. Stuckey, A. C. G. Palmer.

*4th Row* :—A. F. Nichols, R. H. Fraser, R. L. Knight, J. West, C. W. L. Fishlock, A. C. Maher, E. S. A. Chin, G. des Grottes, E. N. de Lestang, J. A. McDonald, C. W. Lynn, W. Cook, A. V. Gibberd, R. Turner, A. E. Trotman, E. W. Gaddum, C. A. S. Hyman, H. L. Grogan, H. C. Phillips, C. K. Robinson.

*5th Row* :—R. L. Getty, A. N. Prentice, R. G. H. Wilshaw, C. Thorold, A. Pickles.

articles, are considered in lecture four. The difficult problem of vulcanization is discussed in the fifth lecture, and rubber synthesis in the last.

Altogether, the book is an inspiring testimony to the great service which the science of colloids has rendered to the rubber industry during the past few years, having been in no small measure responsible for much of the advance in our knowledge of the properties and behaviour of rubber and its application to industrial problems.

F. H.

* * *

LATTER DAY RURAL ENGLAND, by S. L. Bensusan. pp. 221. Price 8*s*. 6*d*. Published by Ernest Benn Limited.

The author describes his impressions of an agricultural tour around England the value of which are enhanced when read in conjunction with somewhat similar tours by Sir Rider Haggard in 1901, and Sir Daniel Hall in 1910-13. The picture is a dismal one relieved only occasionally by glimpses of the highly subsidised sugar beet industry, intensive grassland cultivation, poultry keeping, baby beef, enlightened management and unremitting toil.

One gains the impression that the farmer prefers to grow at a loss those crops he considers essential to national safety to those which will afford him a profit. Part of his difficulty is due to the new and high standard of living, to which he tenaciously attempts to cling. The author rightly condemns the tendency of the farmer to look to Government to relieve all his difficulties, and urges that Governmental activities should be confined to channels which enable the farmer to help himself.

Mr. Bensusan describes the farmer as being 'victimized' (page 35), 'exploited' (pages 101, 168 and 173), and 'fleeced' (page 175), by individuals or organisations variously termed 'thieves and profiteers' (page 35), 'clever rogues' (page 93), 'robbers' (page 212), or middlemen. Such abusive terms assist us neither in analysing existing evils nor in formulating measures for their amelioration.

The author has that naive faith in co-operation so dangerously characteristic of the enthusiast. Much of the effort at present expended in vague eulogies of co-operation might more profitably be employed in investigating the mechanism it seeks to replace. This absurd and uncritical faith in co-operation has been responsible for opposition and failure where circumstances have afforded every chance of success. Mr. Bensusan possesses a facile and interesting pen. His 'interludes' describing interviews with various village worthies, are particularly entertaining.

C. Y. S.

* * *

HIDES AND SKINS by J. Schnitzer, United States Department of Commerce. Pages 210, Price 35 cents.

Hides and skins are largely a by-product of the slaughter of livestock. It would not pay to raise animals solely for their skins, consequently the question resolves itself into consideration of the increase or decline in world consumption of meat. Mr. Schnitzer first discusses in general terms the continental trend in livestock production and then deals in a thorough manner with the position of particular countries.

G. W.

* * *

MANUAL OF FOREST ENGINEERING AND EXTRACTION, by J. F. Stewart, F.R.S.G.S., Chapman and Hall, Ltd. London.

Mr. Stewart has skimmed so very lightly over the surface of his subject that it is to be feared that the Forestry student, for whom the book has been written will feel that he has been misled by its title. The art of aligning and constructing roads, for example (Chapter 12) is dismissed in 3½ pages. This book may perhaps best be described as a catalogue containing some excellently clear photographs and illustrations supported by a text in the form of brief explanatory notes.

R. L. B.

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## BOOKS RECEIVED.

WE have to acknowledge the receipt of the following books :—

**AGRICULTURE.**

**The Tropical Crops.** Otis W. Barrett. *The Macmillan Co.*, 17*s*., p. 446.

**BOTANY.**

**Flora of Trinidad and Tobago.** Vol. 1, Part I, Ranales, R. O. Williams. *The Government Printer*, 1*s*., p. 22.

**Flora of Trinidad and Tobago.** Vol. 2, Part I, Rubiales. R. O. Williams and E. E. Cheesman. *The Government Printer*, 2*s*., p. 48.

**GENERAL.**

**Handbook to British Malaya, 1927,** compiled by R. L. German, Malay States Information Agency. p. 192, illustrations 115.

**Illustrated Guide to the Federated Malay States,** edited by C. W. Harrison, Malay States Information Agency, 2*s*. 6*d*., p. 370, illustrations 66.

**Handbook of British North Borneo, 1921.** British North Borneo Chartered Co. p. 112, illustrations 8.

**Handbook of Nyasaland, 1922,** compiled by S. S. Murray. Crown Agents for the Colonies. 5*s*., p. 314, illustrations 12.

**TECHNOLOGY.**

**A Guide to the Preparation of Plantation Rubber.** R. J. Eaton, Rubber Research Inst. of Malaya. $2.00, p. 54.

**ZOOLOGY.**

**The Insects of Bermuda.** L. Ogilvie. Dept. of Agric., Bermuda, p. 52.

## OBITUARY.

**Mr. John R. Bovell, I.S.O., F.C.S., F.L.S.**

The death of Mr. Bovell, which occurred at Trinidad 23rd November, 1928, removes one of the outstanding figures of the sugar-cane producing community of the past half-century. Mr. Bovell made a name for himself in tropical agriculture, but it is in connection with the production of new varieties of seedling sugar-canes that he has been best known. He was associated with Professor (later Sir John) Harrison in the first attempts to raise sugar-cane from seed in Barbados in 1888 and from then to the time of his retirement in 1925, was responsible for the production of enormous numbers of Barbados seedlings many of which have found their way into profitable cultivation in all parts of the sugar-growing world. It is not too much to say that certain of these varieties at different times and at different places have been the salvation of the sugar-growing industry.

Born in Barbados in 1855, Mr. Bovell was educated in that island at the Lodge School and Harrison's College. He served the Government of Barbados from 1883 to 1925, when he retired, having been in charge of the Agricultural Experimental work from its inception and Director of Agriculture for the last 15 years of his period of service. In 1908, he was awarded the Imperial Service Order.

Mr. Bovell's intimate knowledge of Agriculture was widely recognised and he was called upon by Colonial Governments and plantation managements to visit and report on the condition of the sugar-cane and other industries. His reports on visits to Guadeloupe and Martinique, to Porto Rico, San Domingo and St. Croix were of great value to the Governments and Industries concerned.

Mr. Bovell was also greatly interested in the cotton industry in Barbados and devoted a great deal of time to the development of strains suitable for cultivation under local conditions with the result that, in recent years, Sea Island Cotton grown in Barbados has found special favour with brokers and buyers. Agricultural Education, especially by means of school gardens and Local (Peasants) Exhibitions, was greatly stimulated and promoted by his keen interest.

A faithful civil servant, a kindly and courteous gentleman, and an agricultural worker of outstanding merit, Mr. Bovell will long be remembered, and his passing be deeply regretted, by his friends and associates and by all who have been interested in the development of the newer agriculture of the sugar-cane, which has depended on the production of seedling sugar-canes.

H. A. B.

## COLLEGE NEWS.

Mr. R. R. Follet-Smith sailed for England by s.s. *Camito* on 15th December for vacation leave.

* * *

Mr. C. A. de Silva, B.Sc. (Lond.), C.D.A., post-graduate student, arrived from England by s.s. *van Rensselaer* on 25th November.

* * *

Mr. G. E. L. Spencer has been awarded the medal recently presented to the College by Mr. J. W. Stephens for being the best student of the three years Diploma Course.

* * *

We offer our congratulations to Mr. P. E. Turner who has been elected a Fellow of the Institute of Chemistry for researches on Trinidad soils in relation to froghopper blight of sugar-cane.

* * *

Among recent visitors to the College were Professor J. S. Dash, Director of Agriculture, British Guiana, and Mrs. Dash, and Mr. D. B. Kirke of Plantation Waterloo, Nickerie, of Dutch Guiana.

* * *

A very successful meeting of the Trinidad Science Club was held on 29th November, when, in the presence of His Excellency the Governor, Sir Horace Byatt, K.C.M.G., Dr. A. Clark delivered a lecture on "Vitamins."

* * *

Professor T. B. Wood, C.B.E., F.R.S., F.I.C., who was nominated to represent Cambridge University on the Governing Body in January last, and Mrs. Wood, are expected to arrive in Trinidad in the middle of February.

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Our heartiest congratulations and best wishes go to Dr. C. W. Wardlaw, Plant Pathologist for banana research under the Empire Marketing Board, who was married in Port-of-Spain, Trinidad, on 15th December to Miss Jessie Connell.

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Mr. G. Evans, the Principal of the Imperial College of Tropical Agriculture, has been invited by the Secretary of State for the Colonies to attend, as Agricultural Adviser, the West Indies Conference which is to be held at Barbados in January.

* * *

We wish to express our sympathy to Mr. J. M. Ward, who is suffering from a broken leg as the result of an accident which he sustained on 4th December, whilst playing for the College Association Football Team against the Trinidad Constabulary.

* * *

Sir James Currie, K.B.E., C.M.G., Chairman of the Governing Body of the College, is expected to leave England by s.s. *Venezuela* on 12th January, arriving in Barbados on 25th January where he will be met by the Principal and stay for a week to attend the West Indies Conference before proceeding to Trinidad.

A small party consisting of about ten post-graduate students in charge of Mr. R. C. Wood, Professor of Agriculture, will visit St. Vincent during the Christmas vacation. The main object is to afford an opportunity of seeing and studying Sea Island cotton. The party will be away from the College for about a week.

* * *

Dr. and Mrs. J. G. Myers arrived from England by s.s. *Venezuela* on 10th November. As already announced in our November issue, Dr. Myers, who has been seconded by the Bureau of Entomology to spend at least two years in the British West Indies, British Guiana and British Honduras, on behalf of the Empire Marketing Board, will investigate the problem of the biological control of insect pests in those colonies. Dr. Myers is a New Zealander, and was educated at the New Zealand University where he obtained an M.SC., and at Harvard, where, in 1925, he was awarded the SC.D. Dr. Myers and Mrs. Myers, who is also a graduate of the University of New Zealand, and who will assist him in his work, are at present staying with the Principal.

* * *

Mr. J. H. Aikman retired from the post of Assistant Accountant on 30th November, 1928. He had acted in this capacity for about two years and his genial presence will be greatly missed at the College. Mr. Aikman is a retired Bank Manager and his knowledge and experience has proved of great value to the College. He took a great interest in the social side of College life and was good enough to audit the accounts of the College Amalgamated Clubs. We wish him all prosperity and happiness in his retirement.

Consequent on the changes in the accounting system at the College, Mr. W. A. Tansley becomes Accountant on behalf of Messrs. Hunter, Smith and Earle. Mr. L. A. Corbin's new position is that of Chief Clerk and Manager of the Milner Hostel. Mr. Corbin thus severs his direct connection with accounts, but can look back to a long and valuable spell of work as Accountant during the critical early days of the College.

* * *

**Appointments.**

The following appointments of students in residence at the College during the session 1927-28 have been notified by the Secretary of State for the Colonies :—

Mr. F. E. Buckley (A.R.C.S. 2nd class), Superintendent, Agricultural Department, Nigeria.

Mr. J. L. Greig, B.SC. (Agric.), Assistant Agriculturist, Federated Malay States.

Mr. T. H. Nicol, M.A., B.SC., Agricultural Instructor (Sultan Idris College), Federated Malay States.

Mr. H. A. Pieris, B.A. (Cantab.), Divisional Agricultural Officer, Ceylon.

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The subscription to *Tropical Agriculture* is six shillings per annum, post free, Trinidad currency, to all countries within the British Empire or seven shillings, post free, Trinidad currency, to all other countries. Subscriptions can commence at any time during the year.

## AGRICULTURAL EXCURSIONS.

ON Wednesday, 18th November, an excursion kindly organised by the courtesy of the Hon. W. G. Freeman, Director of Agriculture and Mr. Newbold, was made to the L'Ebranche Valley, when the opportunity was taken by a party of students accompanied by the Principal and other members of the staff to inspect one of the cocoa areas infested by witch-broom disease.

Witch-broom specimens were exhibited and methods employed by the Department of Agriculture for combating the disease demonstrated. After lunch Mr. Stell, Government Mycologist, gave a short address on the history and incidence of the disease in Trinidad.

The remaining excursions for the first term have been arranged as follows :—

| | | |
|---|---|---|
| Wednesday, 5th Dec. | ..Rubber | ..Non Pareil Estate. |
| 12th Dec. | ..Coffee | ..Verdant Vale Estate, Arima. |
| 19th Dec. | ..Forestry | ..Arena Forest Reserve. |

The following is a provisional list of excursions arranged for the Lent term, 1929 :—

| | | |
|---|---|---|
| Wednesday, 16th Jan. | ..Coconut cultivation and copra drying methods | Plein Palais and Concordia Estates. |
| 23rd Jan. | ..Bananas | ..College Research Plots. |
| 30th Jan. | ..Cotton | ..Cotton Research Station. |
| 13th Feb. | ..Cacao cultivation, fermentation and drying | River Estate, Diego Martin. |
| 27th Feb. | ..Sugar-cane cultivation | Caroni Estate. |
| 13th March | ..Sugar manufacture | Usine Ste. Madeleine |

Other excursions may be arranged as opportunity arises.

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## COLONIAL APPOINTMENTS.

The following appointments have been made by the Secretary of State for the Colonies during the month of October, 1928 :

Mr. F. W. Aston, M.R.C.V.S., Veterinary Officer, Kenya.

Mr. C. Cairns, Assistant Conservator of Forests, Federated Malay States.

Mr. R. D. Catterall, Assistant Conservator of Forests, Nigeria.

Mr. S. F. Clay, Senior Agricultural Officer, Uganda.

Mr. K. D. R. Davis, Superintendent, Agricultural Department, Nigeria.

Mr. R. G. McK. Willan, Assistant Conservator of Forests, Nigeria.

Mr. H. M. Salusbury, M.R.C.V.S., D.V.H., Veterinary Officer, Tanganyika Territory.

Mr. R. M. Steven, Produce Inspector, Agricultural Department, Nigeria.

Mr. C. Swabey, Assistant Conservator of Forests, Trinidad.

Mr. D. Thornton, Superintendent, Agricultural Department, Nigeria.

## TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Since the last report a better feeling has prevailed and a general increase in activity has been experienced. Prices have ranged as follows:—Foreign, *c.i.f.*, per cwt., 9*s.* 7½*d.* (6th Nov.), 10*s.* 0*d.* (12th Nov.), 10*s.* 6*d.* (28th Nov.), 10*s.* 3*d.* (3rd Dec.), preferential, *c.i.f.*, per cwt., 13*s.* 4½*d.* (6th Nov.), 13*s.* 9*d.* (12th Nov.), 14*s.* 1½*d.* (28th Nov.), 14*s.* 0*d.* (3rd Dec.). Messrs. Czarnikow write that similar activity in the United States appears in some degree to have been encouraged by rumour of the possibility of an increase in the United States sugar tariff in the near future.

* * *

COTTON.—(15th November Mid-American 10.54*d.*). The Bureau report was issued as: Crop 14,133,000 bales, yield per acre 150.6 lb., ginned to 31st October 10,161,000 bales. The crop was rather smaller than expected, and, since the publication of the report, a quiet steady tone has been shown with fair advance in prices. Interest is now centering on consumption prospects, and these are quietly encouraging. Spinner's takings of American in Lancashire lately have gradually improved. The Egyptian market has not shown much feature. A moderate business has been done in Sea Island.

* * *

COCOA: *6th December.* The cocoa markets still continues very dull and, if anything, values generally are lower than a month ago. At the moment New York prices are unattractive for Trinidad cocoa and whatever sales are being made are for United Kingdom/Continent. London values for spot cocoa are now at 58*s.* L.L.T., which compares very unfavourably with what was being paid a year ago. Likewise, cocoa for shipment is fully 12*s.* per cwt. cost and freight less than at this time last year. Generally the situation appears to depend on the size of the Accra and Nigerian crops. In so far as the manufacturers are concerned, their view is that consumption has fallen off somewhat during the last two years.—(*By courtesy of the Cocoa Planters' Association, Trinidad.*)

* * *

COFFEE.—Mid-November reports state that Vera Paz coffee was offered at 180*s.* per cwt. for prompt shipment; Salvador offered at 160*s.* per cwt. Kenya showed even more variety than usual; 100*s.* to 149*s.* in an exceptionally wide range. For Kilimanjaro 130*s.* was paid, for Colombian 141*s.* was made on spot, while for January shipment prices suggested, *c.i.f.*, are Medellin 150*s.*, Bogota 142*s.* 6*d.* and Bucaramanga 140*s.*

* * *

TEA.—Special sales of tea include, since 1st November, Kasinder (Sumatra) at 17*d.*, Jaipur (Assam) at 25*d.*, Jungpana (Darjeeling) at 25*d.*, Pita Ratmalie (Ceylon) at 28*d.*, Tanara (Java) at 20*d.*, Windoe (Java) at 18½*d.*, and Keemun (China) at 28*d.* per lb. Russia is buying tea more freely. Latest London averages include Ceylon 21.08d., Darjeeling 19.08*d.*, Indian 15.14*d.*, Java 12.73*d.*, Sumatra 14.66*d.*, and Assam 17.12*d.* This year's (1928) crop in India is believed to exceed that of 1927, but to be rather below that of 1926, a year of distinctly good yield.

* * *

RUBBER.—Restriction passed away on its sixth birthday, 1st November, but its death passed practically unnoticed amongst the price quotations. By the middle of the month the market began to weaken and although some recovery was made the official spot buyers' price on 3rd December was 8½*d.* as against 8¾*d.* to 8⅞*d.* at the beginning of November. Messrs. Symington and Sinclair believe that the present weakness is due very largely to depressing tactics by potential buyers in order to make their purchases as cheaply as possible.

* * *

COPRA.—Mid-November prices were as follows: F.A.Q. Ceylon to London, £27 per ton; Sundried Straits to Rotterdam, £26; Straits to Marseilles, £24. 15*s.* 0*d.*

* * *

SPICES.—Business in *Pimento* is reported on *c.i.f.* terms at 98*s.* per cwt. January shipment. Spot is quoted at 11½*d.* for fair; but there is little offering. Jamaica *Ginger* is in quiet demand; but there is no pressure to sell. Quotations range from 85*s.* to 125*s.* according to quality. *Nutmegs* are quiet but steady at: unassorted sound 1*s.* per lb.; bold, slightly defective 1*s.* 3*d.*; wormy and broken ¾*d.* dearer at 8*d.* per lb. *Mace* is quiet but steady. The last quotations of 3*s.* 3*d.* to 3*s.* 7*d.* per lb. for fair reddish to good pale West India are unchanged.—(*W. I. C. C., 15th Nov.*)

* * *

LIME PRODUCTS.—*Lime Oil.* Handpressed is in demand, but there are no supplies. Distilled is firmly held, but no business on the spot is reported. *Lime Juice.* Concentrated is firm and unchanged at £25 12*s.* 6*d.* Raw is firm at 2*s.* 6*d.* to 3*s.* 9*d.* per gallon, according to quality.—(*W. I. C. C., 15th Nov.*)